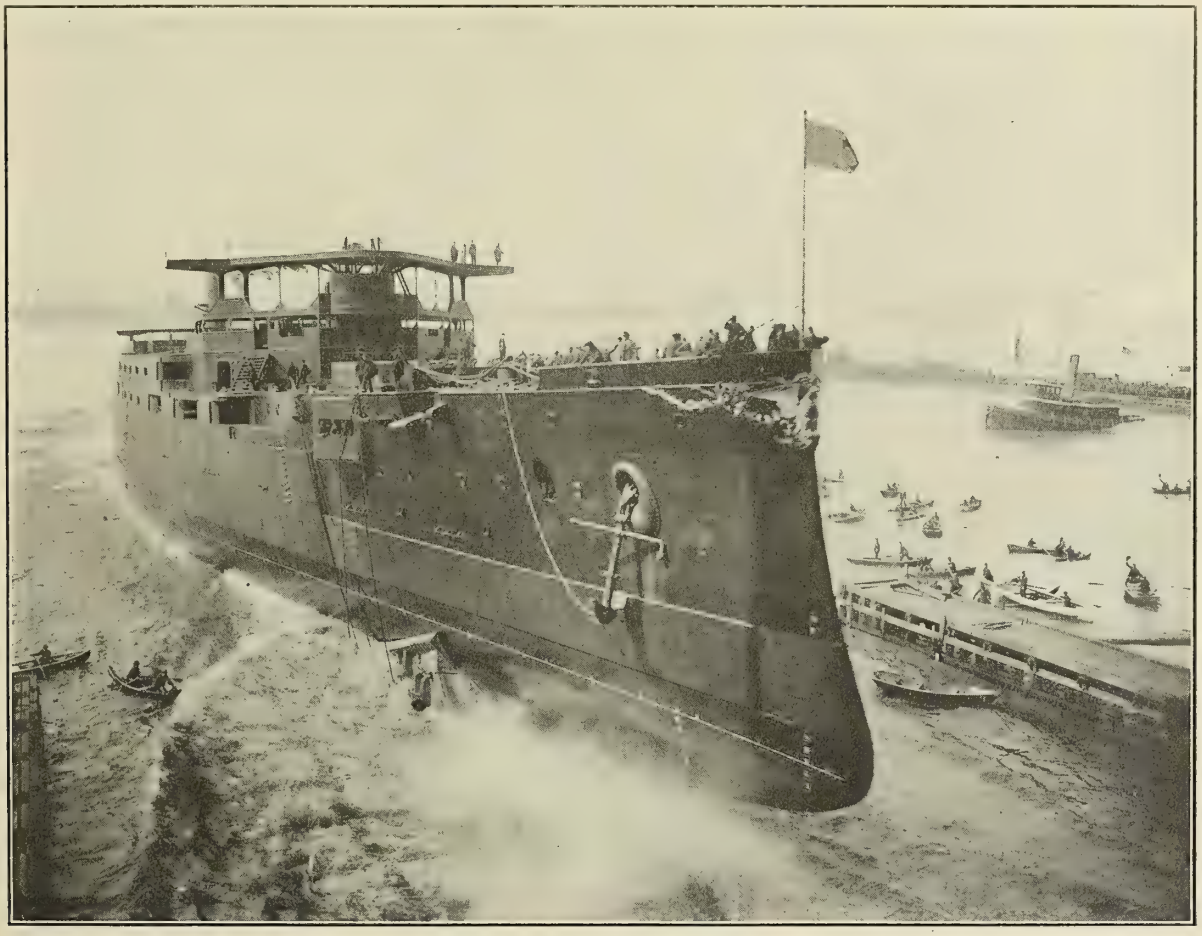
Marine Engineering

MAY, 1905.

PATENT OFFICE MAY 1 1905

THE LAUNCH OF THE UNITED STATES ARMORED CRUISER WASHINGTON.

On the 18th of March the New York Shipbuilding Company sent into the water the new armored cruiser *Washington,* which they are building for the United States government. The *Washington* is one of two armored cruisers whose construction was authorized by Congress on July 1, 1902. The contract for the construction of this ship was signed on the 10th of February, 1903, being one day later than the signing of the contract for her sister ship *Tennessee,* which is being built by the William Cramp & Sons' Ship and Engine Building Company, of Philadelphia. The keel of the *Washington* was laid on September 23, 1903, and the contract date of completion is August 10, 1906. The contract price for the construction of the hull and machinery is $4,035,000.



THE LAUNCH OF THE WASHINGTON.

(Photo by W. H. Rau.)

The *Washington* is a powerful armored cruiser with a trial displacement of 14,500 tons, a full load displacement with all coal and stores on board of 15,712 tons, engines designed for 23,000 horsepower, and an estimated speed of 22 knots. The length on the water-line is 502 feet, the beam 72 feet 10 1-2 inches, and the mean draft, corresponding to trial displacement, is 25 feet. The total bunker capacity of the ship is 1,762 tons, of which amount 900 tons, known as the normal supply, will be carried on trial.

The main battery is an unusually powerful one for a ship of this type, and really entitles the ship to be classed, not as an armored cruiser, but as what might be called a battle cruiser, being somewhere between an armored cruiser and a battleship. It consists of four 10-inch rifles mounted in pairs in turrets on the center line forward and aft; sixteen 6-inch, and twenty-two 3-inch rapid-fire guns, and four 21-inch submerged torpedo tubes; together with a secondary battery of twelve 3-pounder and four 1-pounder rapid-fire guns, two machine guns, two 3-inch field guns, and six Colt automatic guns.

The armor consists in a water-line belt running completely fore-and-aft and having a thickness of 5 inches; barbettes for the

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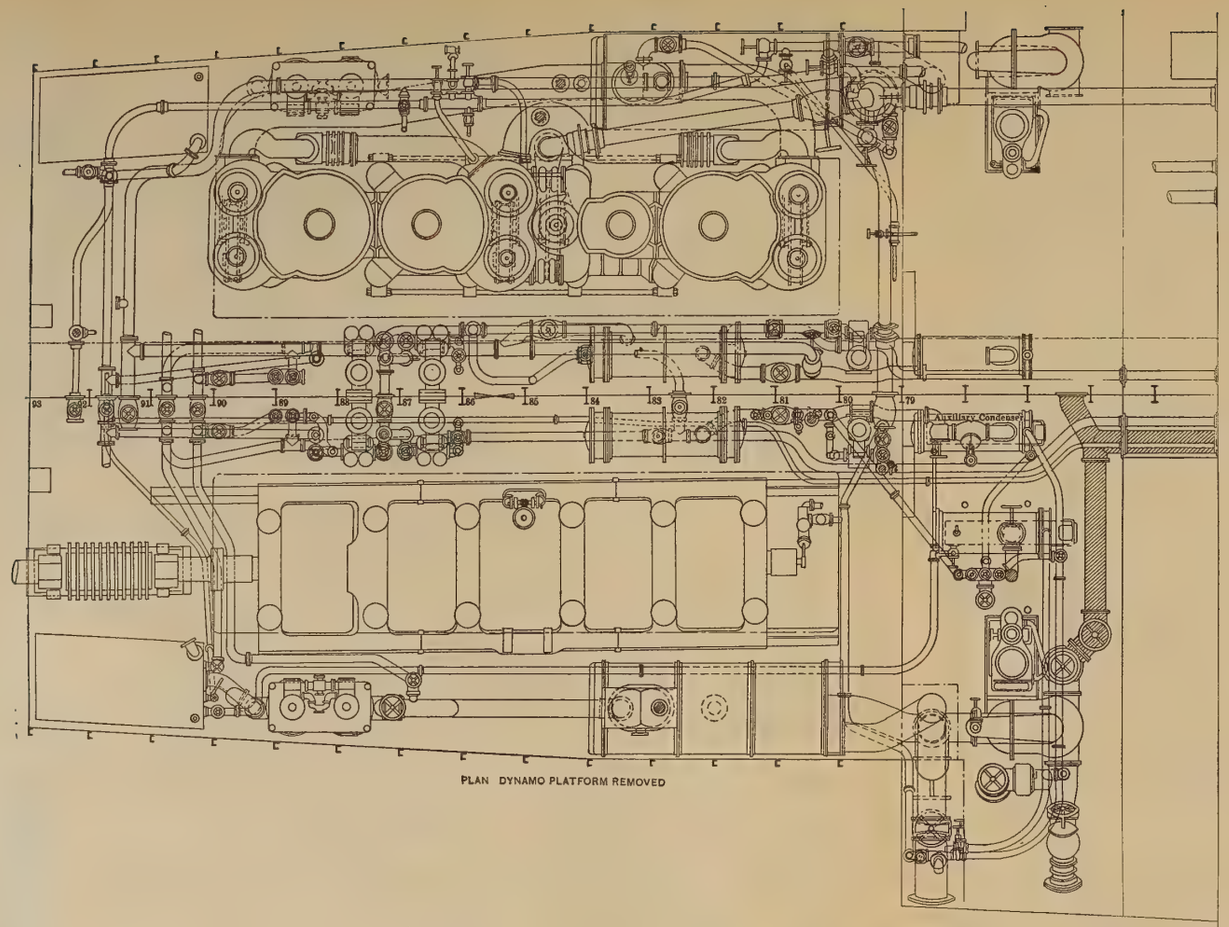
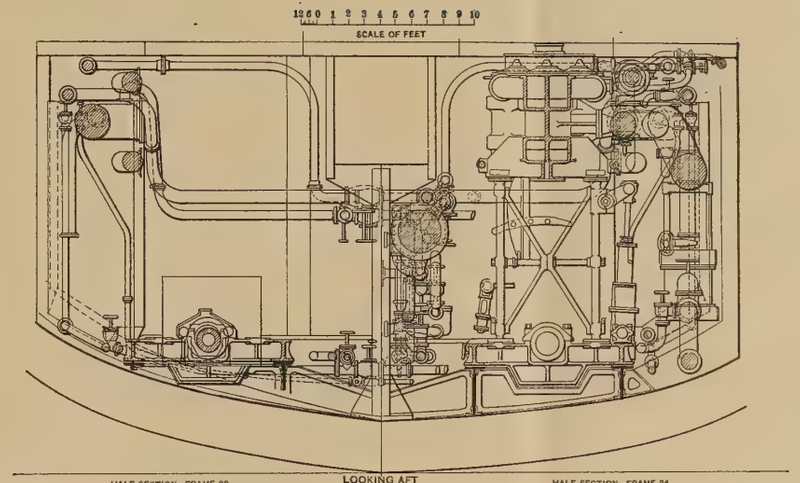
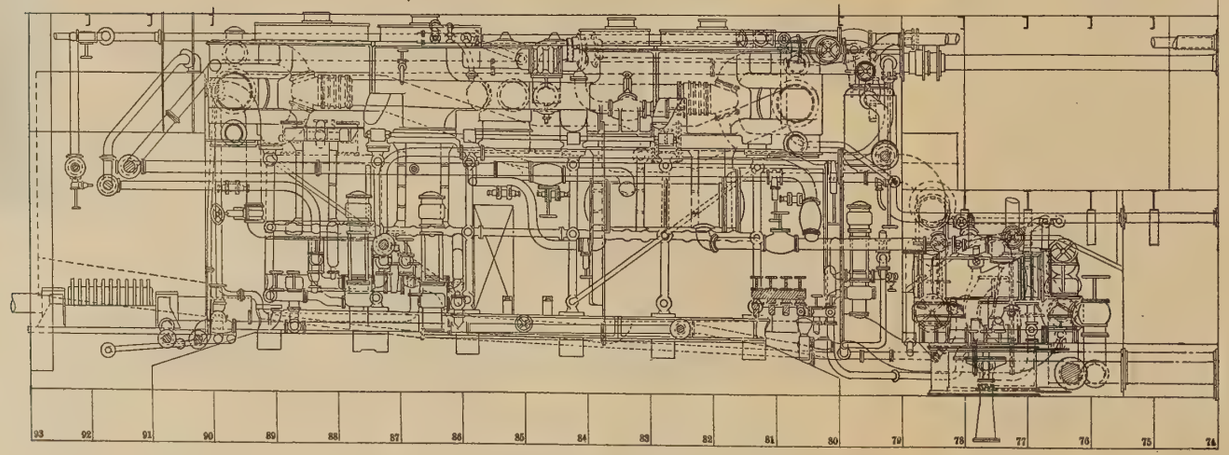


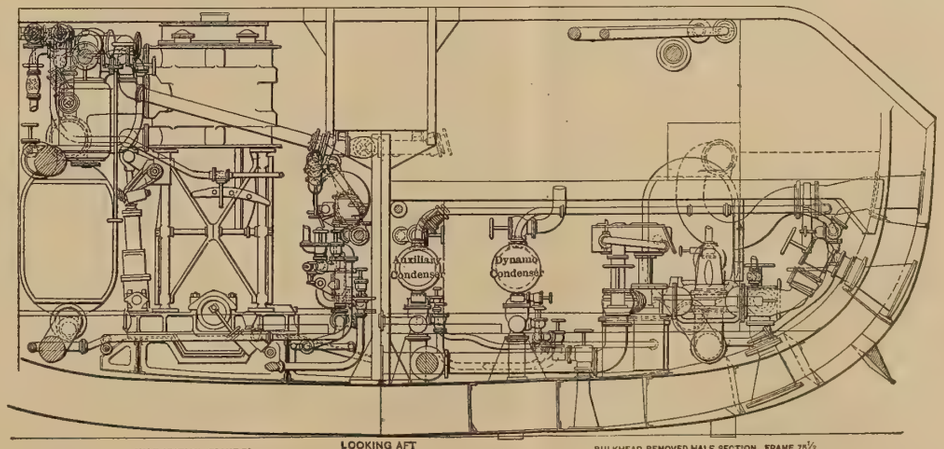
PLAN DYNAMO PLATFORM REMOVED



HALF SECTION, FRAME 89 — LOOKING AFT — HALF SECTION, FRAME 84



PORT SIDE ELEVATION, CENTRE LINE BULKHEAD REMOVED



HALF SECTION, FRAME 79 — LOOKING AFT — BULKHEAD REMOVED HALF SECTION, FRAME 75½

Marine Engineering

GENERAL ARRANGEMENT OF MACHINERY ON THE NEW UNITED STATES ARMORED CRUISERS MONTANA AND NORTH CAROLINA.

10-inch guns, having a thickness of 7 inches on the exposed parts and 4 inches where protected by the water-line belt and other side armor; and turrets having a thickness of 9 inches on the port plates, 7 inches on the sides, and 5 inches in the rear.

The propelling machinery consists of two four-cylinder, triple-expansion engines, the combined horsepower being, as mentioned above, 23,000. The steam pressure at the engines is to be 250 pounds per square inch. Each engine has cylinders of the following diameters: 38 1-2 inches, 63 1-2 inches, and two of 74 inches, the stroke in each case being 48 inches. At maximum power the engines and screws will make 120 turns per minute. Each engine is located as usual in a separate water-tight compartment, and is provided with all the regular auxiliaries as required by the Bureau of Steam Engineering. There are sixteen water-tube boilers, placed in pairs in eight water-tight compartments, and served by four funnels. The total grate area is about 1,600 square feet and heating surface about 68,000 square feet, the ratio being nearly 43 to 1.

Our illustration shows the ship just as she has cleared the ways and is in process of becoming water-borne. The launching ceremony was performed by Miss Helen Stuart Wilson, daughter of ex-Senator John L. Wilson, of Washington.

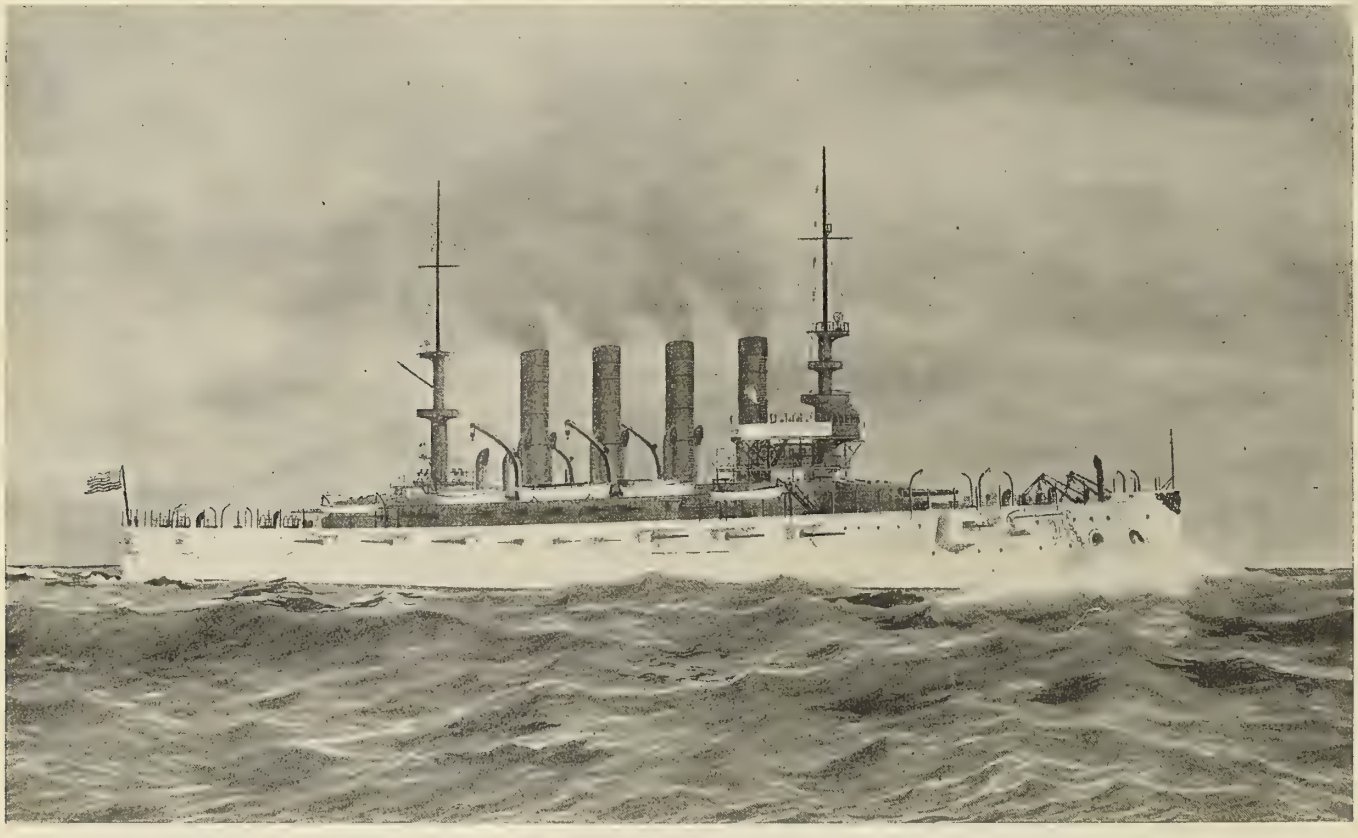
THE MACHINERY OF THE ARMORED CRUISERS NORTH CAROLINA AND MONTANA.

These two armored cruisers were authorized by Congress about a year ago, and have the following principal dimensions:

Length on load water-line	502 feet
Extreme beam	72 feet 10 1-2 inches
Mean draft, corresponding to trial displacement	25 feet
Displacement on trial	14,500 tons
Total coal-bunker capacity	2,000 tons
Coal carried on trial	900 tons

With a battery comprising four 10-inch rifles, sixteen 6-inch, and twenty-two 3-inch, rapid-fire guns, and four submerged torpedo tubes, as well as a secondary battery of twelve 3-pounder and four 1-pounder semi-automatic, rapid-fire guns, and four machine guns, these ships represent a type which is as powerful as any armored cruisers yet designed. The Newport News Shipbuilding and Dry Dock Company is under contract to build these two ships, at a cost, exclusive of armor and armament, of $3,575,000 each.

The propelling machinery consists of two four-cylinder, triple-expansion engines of a combined indicated horsepower of about 23,000, and arranged for outboard turning propellers when going forward. The steam pressure at the engines is designed to be 250 pounds per square inch. The cylinder diameters of each engine are 38 1-2 inches for the high-pressure, 63 1-2 inches for the intermediate-pressure, and 74 inches for each of the two low-pressure cylinders; the stroke in each case being 48 inches; the number of revolutions per minute at maximum power is about 120. Each engine is located in a separate water-tight compartment, and is provided with all the usual auxiliaries in accordance with the latest practice of the Bureau of Steam Engineering. There are sixteen water-tube boilers placed in pairs in eight water-tight compartments; the total grate area being about 1,590 square feet and the heating surface aggregating 68,000 square feet; this giving

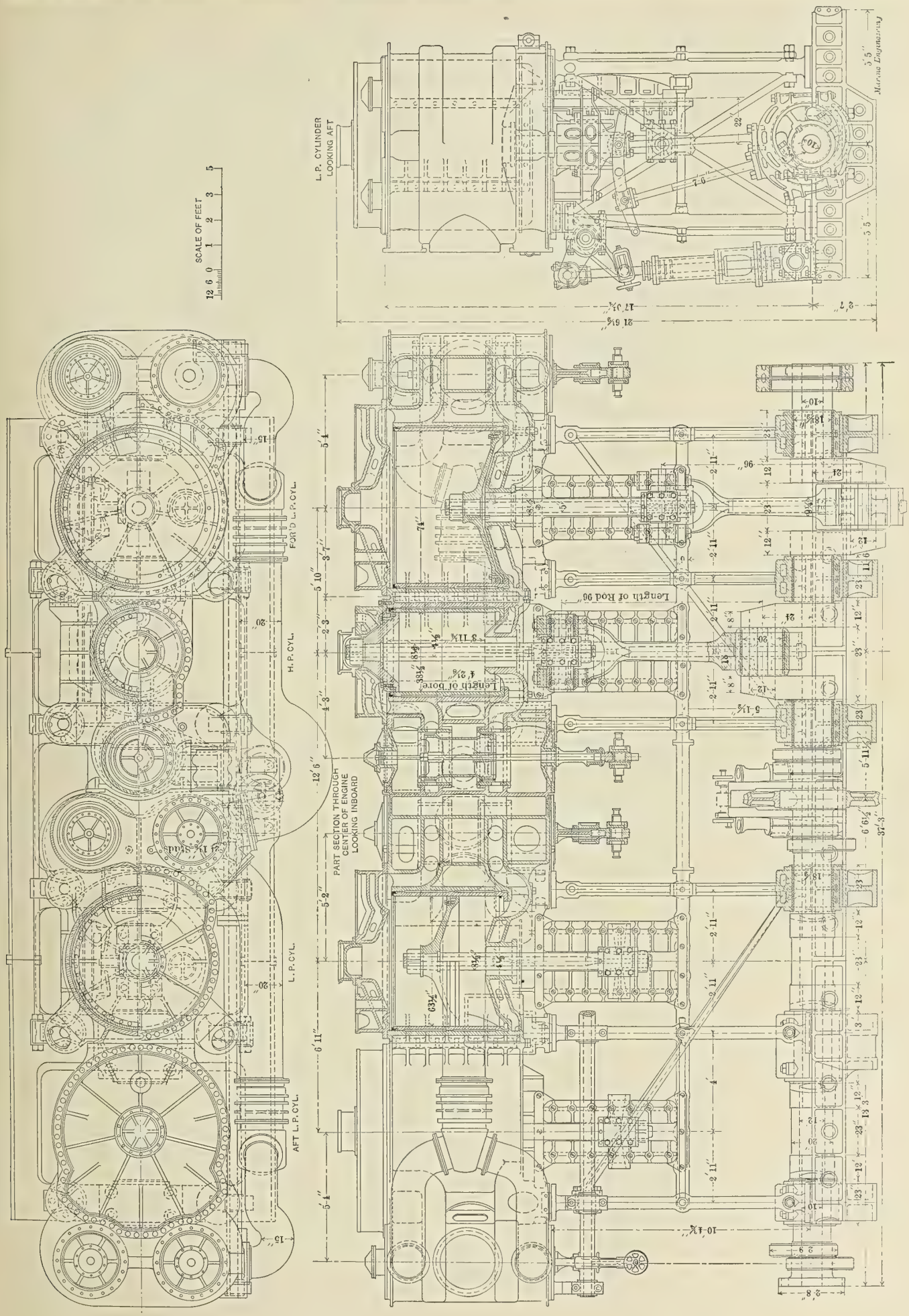


THE ARMORED CRUISER MONTANA, SISTER TO NORTH CAROLINA, WASHINGTON AND TENNESSEE.

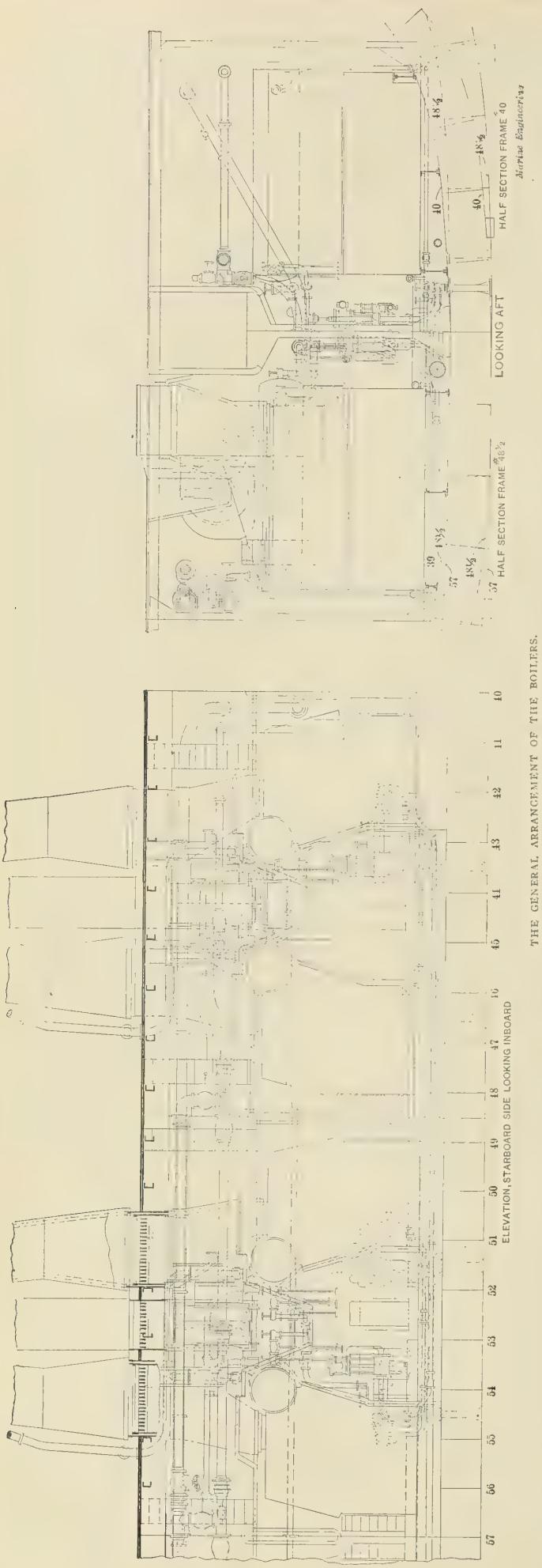
Drawn by W. R. C. Wood.

Opinion of a Gloucester Fisherman.

"I always said that them cup races, when a couple o' shingles, with junks o' led stuck on their bottoms, run around a thirty-mile triangle, with a lot o' dinky steam yachts alongside, an' a mob of old *Gen. Slocum's* with seasick landlubbers goin' along to keep them company, an' the wind blowing five knots, and the sea like a mill-pond, weren't races. They're marine circuses. For a real race, take two boats an' give them a fair test. Let them have fair weather an' foul, high wind an' low, fog an' clear, hurricanes an' gales, an' let them run a few thousand miles. Then, if either o' them is still on top of the water, the one that gets in first is the best, an' there ain't no gainsayin' it."



THE FOUR-CYLINDER, TRIPLE-EXPANSION MAIN ENGINES OF THE MONTANA.



THE GENERAL ARRANGEMENT OF THE BOILERS.

a ratio of heating surface to grate area of 42.8 to 1. The working pressure in the boilers will be 265 pounds per square inch, this allowing a gradient of 15 pounds between boiler and engine. The length of grates will be about 6 feet 10 inches, and the steaming capacity such that all steam machinery on board can be run at full power with an average air pressure in the fire rooms of not more than 2 inches of water. There are four funnels, which measure about 100 feet above the base line. Sixty-six tons of fresh water will be carried on trial in the double bottom or in reserve tanks. The weight of all machinery, tools, stores, and spare parts is not to exceed 2,060 tons.

As shown by illustration, the cylinders are located from forward aft: low-pressure, high-pressure, intermediate-pressure, and low-pressure; the distances between centers being respectively 5 feet 10 inches, 12 feet 6 inches, and 6 feet 11 inches, the cylinder axes being all in one plane and parallel to each other. The high-pressure cylinders have barrels of a thickness of 2 1-4 inches; the intermediate-pressure barrels are 2 inches thick; and the low-pressure 1 3-4. Each cylinder is fitted with a liner having thicknesses respectively 1 3-4, 1 3-4, and 1 1-2 inches, which liners are bored after being placed in the cylinders. These liners are counterbored at both ends, leaving the working bores of such length that the piston rings will over-ride 1-4 inch at the top and 1-8 inch at the bottom. The linear clearances of the various cylinders between pistons and cylinder heads will be 3-8 inch at the top and 5-8 inch at the bottom.

The high-pressure cylinders will be fitted with one piston valve of a diameter of 24 1-2 inches. Each of the other cylinders will have two piston valves of a diameter of 27 inches. These valves operate in valve-chest liners, having a thickness in each case of 1 3-8 inches.

The high-pressure pistons and followers are made of cast iron, while the intermediate and low-pressure pistons are of cast steel. Each piston has a hard cast-iron packing ring, 1 inch thick and 2 1-2 inches wide on the bearing surface, cut obliquely and fitted with a tongue, the play of the ring being limited by means of an adjustable distance piece. The piston rods are all of the same size, having an external diameter of 8 1-2 inches. They are bored to different sizes, however, the inside diameter of the low-pressure rods being 5 inches, reduced to 2 inches at the cross-head end; while the bore of the other rods is 4 1-2 inches reduced to 1 1-2. The cross-head pins are 10 3-4 inches in diameter and 11 inches long, having axial holes. The connecting rods are 96 inches long between centers, and are turned to a minimum diameter of 8 1-4 inches at the cross-head end and 9 1-4 inches at the crank end.

There will be two sections of crank shaft for each propelling engine, each section having two cranks and coupling disks, as shown in the illustration. The radius of cranks is, of course, 24 inches, and the coupling disks will have a thickness of 4 1-2 inches and a diameter of 32 inches. The journals are 18 1-2 inches in diameter and the crank pins 20 inches in diameter and 23 inches long. The crank webs are 12 inches thick and 21 1-4 inches wide, and are chamfered. A 12-inch hole is bored through each crank pin and a 10-inch hole axially through each shaft. The thrust shafts have a diameter of 17 1-2 and 17 3-4 inches with a 10 1-2-inch axial hole, and an over-all length of 24 feet 11 1-2 inches. Each shaft has 12 thrust collars 2 inches wide and 27 inches in diameter, separated by spaces of 4 inches each. The coupling disks, forged on the forward and after ends of the thrust shaft, are of the same size as those on the crank shaft, except that the diameter of the after coupling disk is 33 1-2 inches. There is one section of stern-tube shafting for each engine, supported on two stern-tube bearings, and measuring 18 1-2 inches in diameter except at the forward end, where a diameter of 20 1-2 inches has been adopted to form a seat for the forward collar of the coupling. These shafts are 52 feet long and have 10 1-2-inch axial holes, reduced in the after couplings to 7 inches. The propeller shafts are 18 1-2 inches in diameter with a 10 1-2-inch hole tapered to 7 inches at the forward end and to 4 inches in the propeller hub. These sections of shaft are about 48 feet 11 inches in length. The

taper of the propeller shaft within the propeller hub is 1 inch in diameter per foot of length.

Each crank shaft has six bearings, of which five are 23 inches long, and the fifth, counting from forward, is 36 inches long. The stern-tube bearing in each case consists of a composition bushing made in halves, and fitted with sections of lignum-vitæ, so placed as to wear on the end of the grain, and held in place by flat rings. The bearings in the struts and stern brackets will also be lined with lignum-vitæ.

There will be two main condensers, one for each engine, and each having a cooling surface measured on the outside of the tubes of about 14,400 square feet. These condensers are oval in form and measure about 9 feet 4 inches high and 5 feet 8 inches wide. The shell has a thickness of 5-16 inch with double butt joints and with circumferential and longitudinal stiffening. Each condenser contains 6,292 seamless drawn tubes 5-8 inch outside diameter, 14 feet long between tube sheets and spaced 15-16 inch between centers; the thickness of the metal in these tubes is No. 16 B. W. G. The tubes are formed of a composition consisting of copper, 70; tin, 1; and zinc, 29 percent. Auxiliary condensers are fitted in each engine room for taking care of the exhaust from all of the auxiliary machinery and have each a cooling surface of about 600 square feet. Dynamo condensers in the dynamo room have each a cooling surface of about 700 square feet.

The main air pumps are two in number, one for each condenser, and are double, vertical, and single-acting, with two inverted steam cylinders. The diameter of the steam cylinders is 14 inches; of the air-pump cylinders, 35 inches; and the length of the common stroke, 18 inches. The suction and discharge openings have diameters 13 and 11 inches respectively. There are two main circulating pumps, each driven by an independent compound engine, and having sufficient capacity to discharge 15,000 gallons of water per minute, at a speed of revolution not exceeding 265. The suction and discharge nozzles have openings equivalent in area to that of a circle 21 inches in diameter.

The main steam pipes, which are of seamless drawn steel, are arranged symmetrically in two systems, one on each side of the ship. An 8-inch branch pipe will lead from each compartment of two boilers. These 8-inch branch pipes will take steam directly from the auxiliary steam pipes, and so indirectly from the boilers. The branches from the forward two compartments will unite into an 11-inch pipe, the diameter of which will be increased at successive junctions to 12 inches and to 13 inches. The auxiliary steam pipes are 8 inches in diameter and extend fore-and-aft from the boiler compartments, one on each side of the ship. Each auxiliary steam pipe connects with the main stop valves of all boilers on its own side of the ship through 5 1-2-inch branches.

Before being placed on the vessel the boilers will be tested to a pressure of 400 pounds above the atmosphere; the high-pressure cylinders, jackets, valve-chests, and connections, as well as all steam pipes and valves subject to boiler pressure, and the evaporator tubes, will be tested to the same pressure of 400 pounds per square inch. The feed-water heaters on discharge side of pumps, the feed-pump water cylinders, valve chests, and air vessels, will be tested to 500 pounds; the fire and bilge-pump water cylinders, valve-chests, and air-vessels will be tested to 225; the intermediate-pressure cylinders, jackets, valve-chests, and connections to 200 pounds; the low-pressure cylinders, and the feed-water heaters on the suction side of the pumps to 100 pounds; the evaporators and distillers to 50 pounds, and the condensers and exhaust valve-chests of the low-pressure cylinders to 30 pounds.

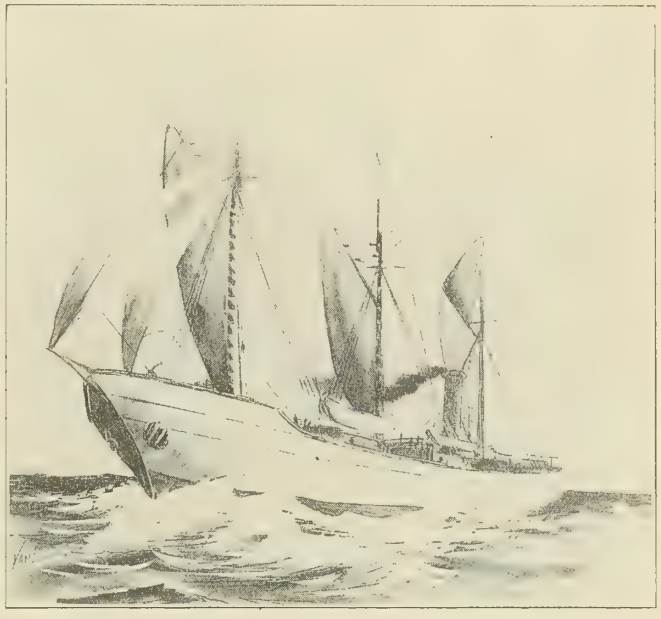
The old wooden frigate *Hartford,* Admiral Farragut's flagship at the battle of Mobile Bay, in the Civil War, has seen her last sea service, and after repairs at the Norfolk navy yard will be placed on the list of historic naval vessels and sent as permanent station ship to the Annapolis naval academy. She was illustrated on page 107 of our March number.

PEARY'S LATEST ARCTIC SHIP, THE ROOSEVELT.

Peary's new Arctic ship, the *Roosevelt,* now receiving her machinery and finishing touches at Portland, Me., preparatory to being brought to New York for fitting out in the fore part of June, is a remarkable craft, unique in part, and at the same time combining all the experience of Arctic craft to date. The *Roosevelt* is now about 70 percent complete, and we are able to give our readers the first authentic description of this vessel together with the design plans.

In his latest, and what is to be his final effort to reach the North Pole, Commander Peary has united the fruits of his own experience in the past, together with the difficulties which have confronted his rivals in this forbidding, albeit fascinating field of geographical research.

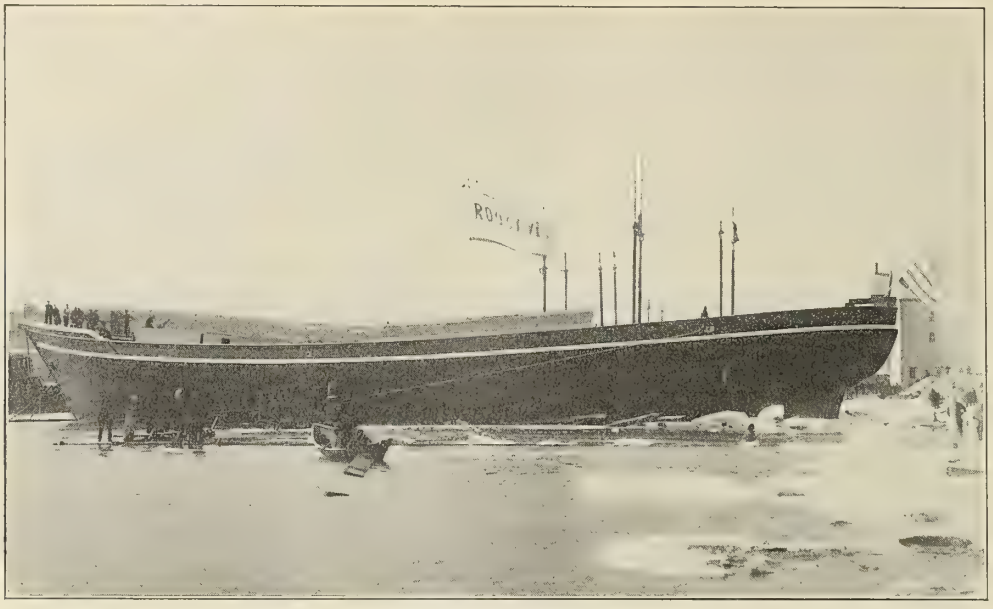
This last Arctic ship is naturally very remarkable in many ways. Physical hardiness and a determined spirit to buck against the seemingly insuperable difficulties presented by the icy barriers of the Far North are not enough, as the past has proved, to reach the North Pole. The prime question, even despite the intense cold, is one of provisioning; and successful provisioning demands that supplies be carried to the North to the utmost limits of navigation and in sufficient quantity to last at least two years.



THE ROOSEVELT AT SEA.

To carry so large a mass of stores into and through the many obstructive leagues of dodging ice floes in a minimum coal consuming vessel, calls for a craft of peculiar qualities. The vessel must be large enough to carry a coal supply that will insure her steaming endurance through months of isolation from the coal heaps of civilization. She must be able to carry all of the edible supplies, clothing and special equipment demanded by her personnel. She must carry spare parts and ship's stores enough to last for two years, for this rigorous work calls for continual repairs, which are at times vital to the welfare of the entire expedition. Finally, the craft must be strong enough to pound, pound and pound for months at a time against the ice-bound channels of that inhospitable region. Experience has demonstrated that the sturdy whalers, stout as they are, are not strong enough for this persistent attack, and, to provide for this almost disheartening work, this new ship was especially designed and constructed. All that the cunning of past experience and the acme of the art of ship construction in wood can accomplish is combined in Peary's new ship, in form of hull, structure, machinery, rig and outfit.

The model of the hull is rather bluff, and lies fairly low in the



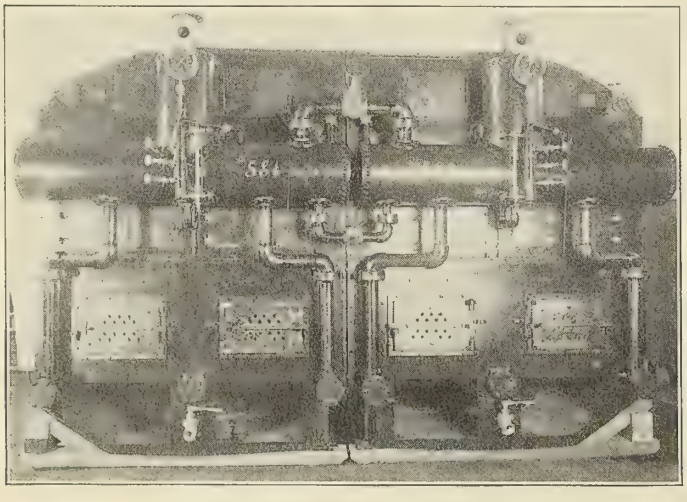
LAUNCH OF THE ROOSEVELT.

(Photograph by J. O. Whittemore.)

water, and is suggestive both of strength and capacity. Probably in no part of the world can be found a model or form of hull similar to this vessel, whose mission is to drive into, break down and force away the ice fields in front, with a stern so shaped that the over-hanging portion will more or less protect the screw when the heavy ice floes come together against the vessel's quarters. There is no "tumble-home" of the top sides such as may be found in former Arctic vessels, but instead, the top sides "flare out" up to the rail, which admits of working a very heavy guard strake.

The purpose of this guard strake, apart from being a buffer, is to help to lift the vessel out of the water as the ice crushes about her. As can be seen, the ice will press against her sides, and then, as they offer first resistance, it will rise and catch under the counter or over-hang of this guard and bodily raise the vessel. In case the ship, on the other hand, has been frozen in a thick pack of ice, and it is desirable to free her, hydraulic jacks are set upon the ice and brought to bear upon the under side of the guard, and these, in turn, will raise the craft, and as she is permitted to settle back, her own weight and her form, acting as a big wedge, will tend to break a way clear. This is a peculiarly novel arrangement.

Reference to the midship section and the lines will show the combination in form of the old time "frigate floor," and the modern ferry-boat bilge, which, together, gives a body that will admit of the vessel's laying-over on her side without damage, and also gives what is known in ship parlance as a "freeing-section" from lateral compression of ice from without.



THE ALMY BOILERS OF THE ROOSEVELT.

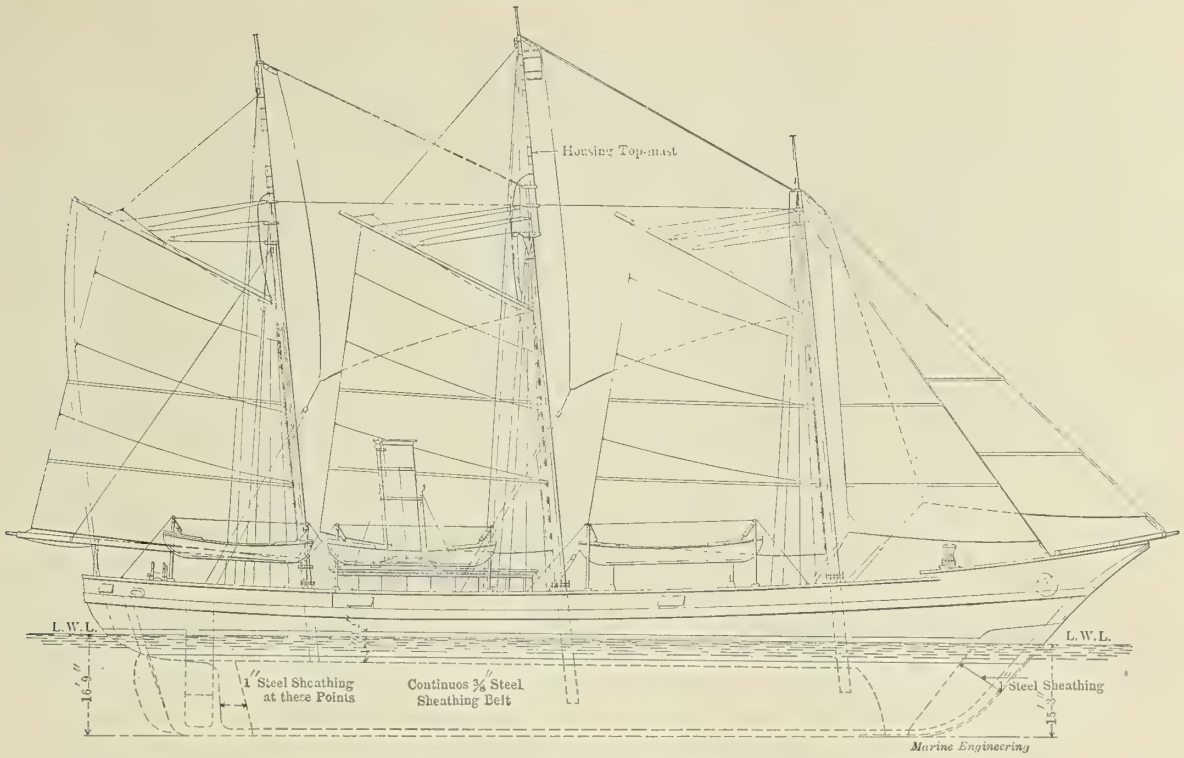
The most important feature of this vessel's form is the bow and forefoot. This is designed so that, when driving into thick ice, the vessel will ride upon the ice and break it down, and at the same time keep the broken ice from piling so high as to be an impediment to the next ramming. The extreme flare of the bows from the water-line to the forecastle deck is also for this purpose. Of the form indicated above, braced, girded and re-enforced as never was craft before, she will be able to withstand enormous pressures from surrounding fields of ice. This squeeze of the ice will tend to lift rather than to crush her in the grasp of the gathering pack. The extreme ferry-boat form of midship section will raise her higher out of the ice, the harder the squeezing becomes.

The vessel is technically described as a "three-masted, fore-and-aft, schooner-rigged steam vessel, with auxiliary sail power," larger than Nelson's famous *Fram*, but about the size of the Antarctic ship *Discovery*. There the similarity ceases, and, in order that our readers may have a better notion of the bulk and build of this unique craft, we give her principal dimensions, as follows:

Length on load water-line (between perpendiculars).	161 ft. 0 ins.
Length on deck (about)	172 ft. 0 ins.
Length over all, from tip to tip of rail (about)	182 ft. 0 ins.
Breadth, molded (to outside of plank at deck beam).	33 ft. 0 ins.
Breadth to outside of plank at load water-line	32 ft. 0 ins.
Breadth, extreme, over guard	34 ft. 2 ins.
Depth, molded (from top of main-deck beam at side to bottom of keel at midship frame)	20 ft. 0 ins.
Draft, forward	15 ft. 3 ins.
Draft, aft	16 ft. 9 ins.
Mean draft, amidships	16 ft. 0 ins.

Her displacement, when ready for sea, and with all coal and stores aboard, will be about 1,500 tons.

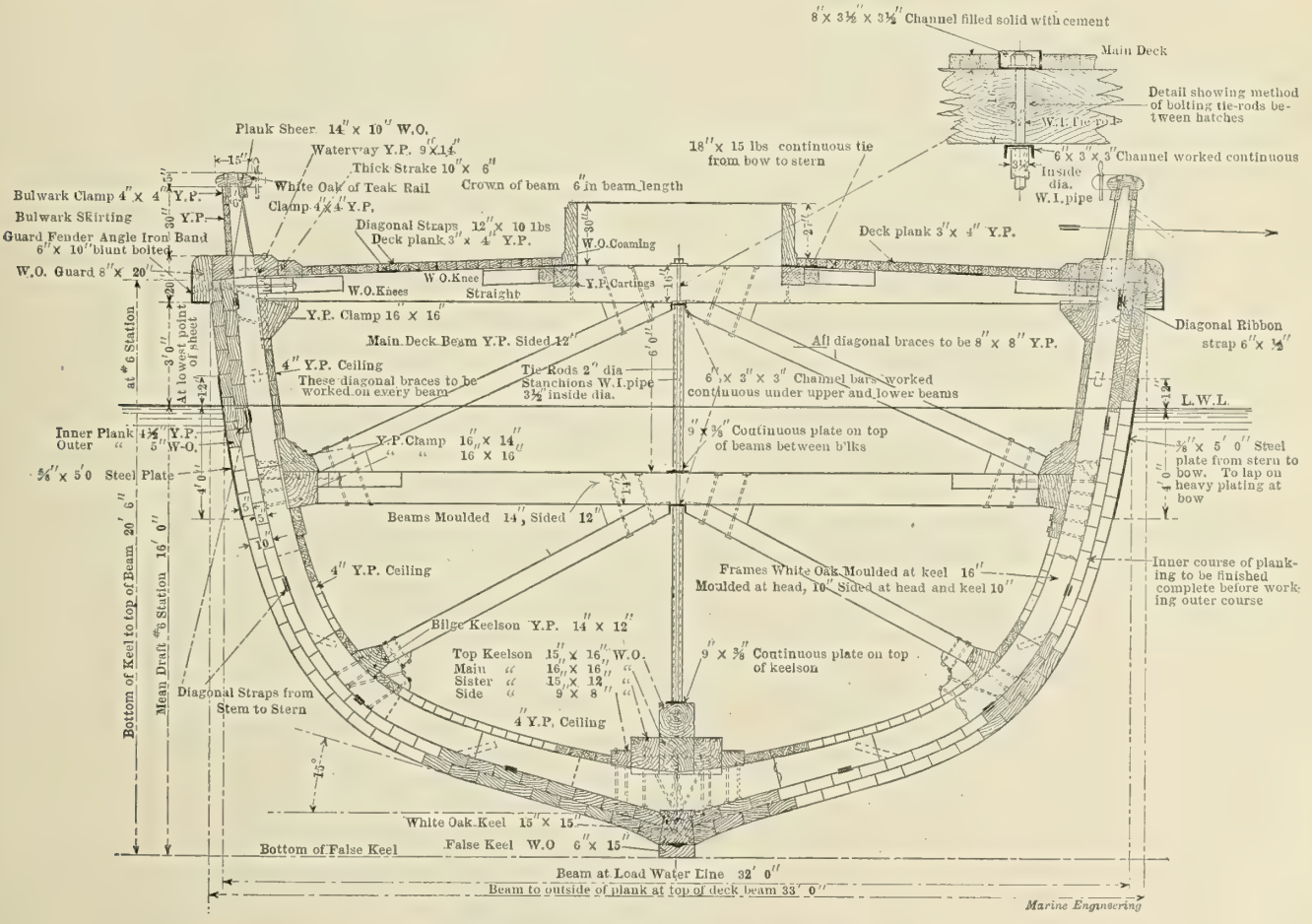
Continuity of strength, fore and aft, laterally and vertically, has been considered in view of the work to be accomplished, as may be noticed from the midship section and inboard profile. When it is considered that the bow framing extends ten feet aft of the stem of solid dead wood, some idea of the terrible pounding this vessel will be able to stand can be appreciated. This solid framing is from the natural white oak crooks, and is bolted from all directions. In addition to this heavy framing, a three-quarter-inch vertical apron plate is worked inside of all to prevent the forward



SAIL PLAN AND OUTBOARD PROFILE OF THE ROOSEVELT.

hood-ends of the double planking from starting during the continual ramming into the ice.

Compared with the United States government revenue cutters *Bear* and *Alert*, and with Arctic whalers of recent years, the *Roosevelt* is a much stronger vessel throughout. She is double-framed and double-planked with two courses of five-inch oak plank, and ceiled on the inside of the frame with three-inch yellow pine ceilings. In addition to this heavy framing, big 14-inch by


8" x 3½" x 3½" Channel filled solid with cement
Main Deck
Detail showing method of bolting tie-rods between hatches
W.I. Tie-rod
6" x 3" x 3" Channel worked continuous
3½" Inside dia. W.I. pipe
18" x 15 lbs continuous tie from bow to stern
Plank Sheer 14" x 10" W.O.
Waterway Y.P. 9" x 14"
Thick Strake 10" x 6"
White Oak or Teak Rail
Crown of beam 6" in beam length
Bulwark Clamp 4" x 4" Y.P.
Bulwark SKirting Y.P.
Guard Fender Angle Iron Band 6" x 10" blunt bolted
W.O. Guard 8" x 20"
Clamp 4" x 4" Y.P.
Diagonal Straps 12" x 10 lbs
Deck plank 3" x 4" Y.P.
W.O. Coaming
Deck plank 3" x 4" Y.P.
W.O. Knee
W.O. Knees
Straight
Y.P. Cartings
Y.P. Clamp 16" x 16"
Main Deck Beam Y.P. Sided 12"
All diagonal braces to be 8" x 8" Y.P.
Diagonal Ribbon strap 6" x ½"
4" Y.P. Ceiling
These diagonal braces to be worked on every beam
Tie Rods 2" dia
Stanchions W.I. pipe 3½" inside dia.
6" x 3" x 3" Channel bars worked continuous under upper and lower beams
L.W.L.
Inner Plank 4½" Y.P.
Outer " 5" W.O.
Y.P. Clamp 16" x 14"
" " 16" x 16"
9" x ⅜" Continuous plate on top of beams between b'lks
⅜" x 5' 0" Steel plate from stern to bow. To lap on heavy plating at bow
⅝" x 5' 0" Steel Plate
Beams Moulded 14", Sided 12"
4" Y.P. Ceiling
Frames White Oak Moulded at keel 16" Moulded at head, 10" Sided at head and keel 10"
Inner course of planking to be finished complete before working outer course
Bilge Keelson Y.P. 14" x 12"
Top Keelson 15" x 16" W.O.
Main " 16" x 16" "
Sister " 15" x 12" "
Side " 9" x 8" "
9" x ⅜" Continuous plate on top of keelson
Diagonal Straps from Stem to Stern
4" Y.P. Ceiling
White Oak Keel 15" x 15"
Bottom of False Keel
False Keel W.O 6" x 15"
Beam at Load Water Line 32' 0"
Beam to outside of plank at top of deck beam 33' 0"
Bottom of Keel to top of Beam 20' 6"
Mean Draft at ⅝ Station 16' 0"
At ⅝ Station
At lowest point of sheer
Marine Engineering

MIDSHIP SECTION SCANTLINGS OF THE ROOSEVELT.

12-inch 'tween-deck beams are worked in every frame at the water-line to prevent lateral crushing of the vessel. Between the main deck and the 'tween-deck beams, heavy athwartship diagonal braces are worked to keep the vessel from being crushed from the bilges upward. The longitudinal strength is maintained in each side by very heavy oak and yellow pine keelsons, clamps, stringers, deck plank and inside and outside planking, all of which is copper bolted in all directions.

To take up any vertical working of the vessel that may occur from months and months of forging into and breaking down the ice, heavy wrought iron tie-rods are fitted from the lower side of the main keel to the top of the deck beams. These tie-rods are run through wrought iron pipes (which act as beam stanchions) and they may be "set up" at will on the main deck.

To take the rub and grind of the floating ice, the bow, the sides along the water-line, and the stern, are protected by steel plating. At the stem this plating, an inch thick, reaches from the keel all the way up to about six feet above the load water-line, and extends aft from the stem for quite twelve feet. This is for protection of the bow when ramming. The water-line plating, which is three-eighths of an inch thick, is a continuous belt five feet wide, one foot above water, and four below. The fact that this steel plating should be required to reinforce the unusually heavy double course of planking is significant of the tremendous wear and tear to which a craft in the Polar seas is subjected.

The sails, which are unusual in form, have sufficient spread to make the vessel thoroughly manageable in case of breakdown of the machinery. They will be used on all occasions to help save coal, and to speed the vessel on her journey northward. The sails will be of heavy canvas and so fashioned that they will be able to stand frequent freezing and thawing, and the driving blast of the Polar region. The arrangement of sail, too, will admit of easy handling by a few men. The rigging, which is not fully indicated in the accompanying cuts, is of the best wire rope, payed all over, and of very heavy scantling. As soon as the vessel reaches the Polar regions she will be stripped of bowsprit and fore and mizzen topmasts, leaving the main topmast only, for the "crow's nest," which is carried at the mast head of the main topmast, from which a lookout will direct the navigation of the craft, when once she has entered the ice floes.

Speed is not the aim of her power, but instead it is intended to enable her to pound her way, day in and day out, through the great ice floes that will surely lie between her and her goal, so that the bunker capacity is for something like 600 tons of coal, which, economically used, should suffice for many months of steady work.

The vessel is heated by steam, but it is not the present intention to light her by electricity, as the heat of oil lamps, not to mention their economy, serves to add that much more to the comfort of her living spaces.

The topgallant forecastle carries the bow high enough to make the vessel reasonably dry in a head sea, while affording space for the accommodation beneath of the Eskimos and their dogs, which will be housed there later on.

The two big deck houses will provide quarters for Commander Peary, the ship's officers, and the members of the scientific staff, including the picked crew of about twenty men. The houses are of peculiar construction and will be portable, the object of this being to enable their removal from the ship to shore if emergency demands, where they may be turned into reasonably comfortable habitations susceptible to economical heating and maintenance. The living quarters are comfortably and substantially finished, but there is no attempt at decoration. The prime aim is utility, and security against the searching winds of the Far North, without adding to the task of keeping everything clean and sanitary. Special provision has been made for the installation of all scientific instruments, and space enough is provided for a small and select library of scientific works, together with a reasonable quantity of general reading matter.

The *Roosevelt* will carry six whale boats. When the Polar region is reached, these boats will be carried in athwartship skids, just forward of the mainmast, and will all be fitted with runners so that provisions can be transported over the ice in establishing the cachés at various points, after the vessel has reached a point where the solid ice prevents her further progress north.

For motive power the vessel has a single engine of the compound condensing type, designed for the economical development of 1,000 indicated horsepower; while, when occasion demands, such for instance as bucking a floe, the engine will be able to develop between 1,400 and 1,500 indicated horsepower.

The vessel will carry a number of ten-foot propellers, all being so arranged that they may be disconnected from the shafting and hoisted up into a well when the vessel is under sail, or when, to guard the propeller against the ice when the vessel is not ramming, it is desirable to house it. With the steam power at her disposal, the ship should be able to make quite twelve knots per hour under the normal development of her power, and with her maximum of 1,500 indicated horsepower, she should make fourteen or fifteen knots. The cost of her hull and machinery, complete, will be about $125,000, about $50,000 of this sum being absorbed by her motive power.

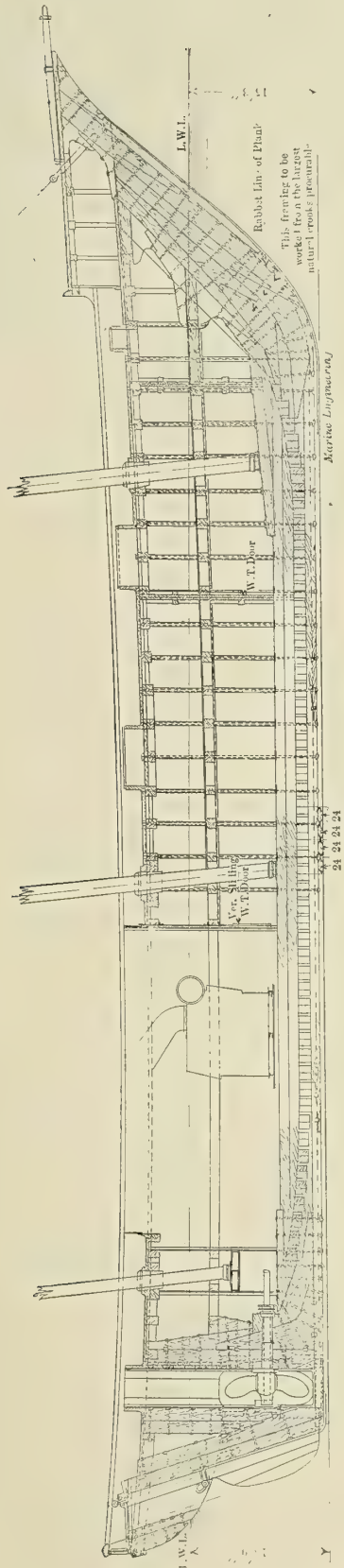
The vessel was designed by William E. Winant, naval architect, of Washington, D. C.; the hull was built by McKay & Dix, of Bucksport, Me., the machinery is being installed by the Portland Company, of Portland, Me., and the boilers are from the shops of the Almy Water-Tube Boiler Company, of Providence, R. I.

The funds for building the *Roosevelt* are from voluntary contributions, and have been furnished entirely by the Peary Arctic Club of New York.

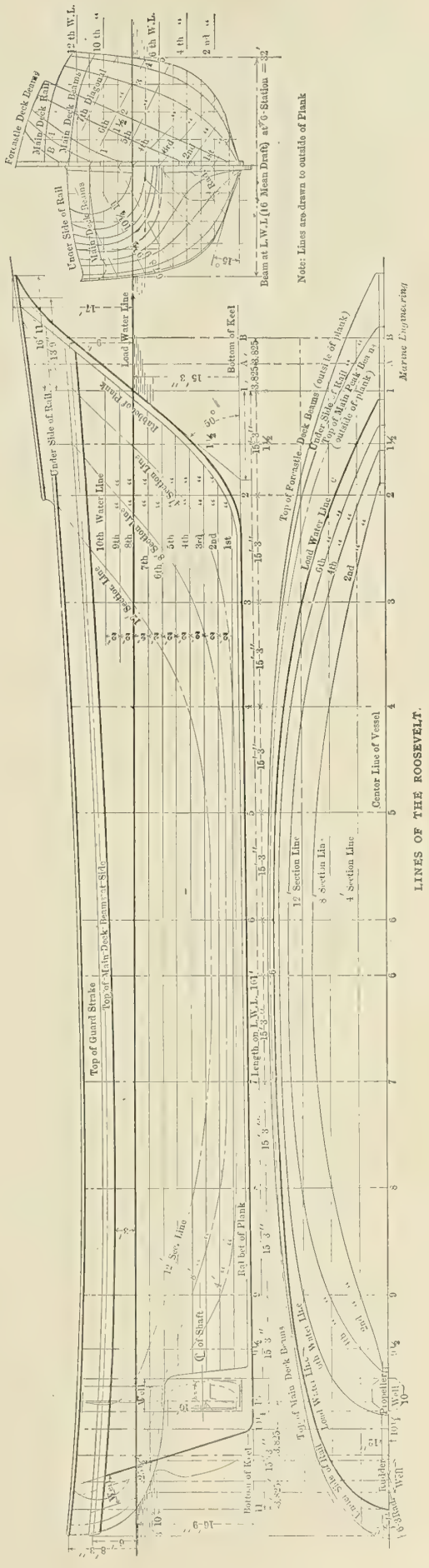
Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, report under date of April 10, 1905, the following percentage of completion of vessels building for the United States Navy:

			Mar. 1.	Apr. 1.
BATTLESHIPS.				
Virginia	19 knots.	Newport News Co.	80.82	83.74
Nebraska	19 "	Moran Brothers Co.	67.59	69.31
Georgia	19 "	Bath Iron Works	75.09	76.44
New Jersey	19 "	Fore River Shipbuilding Co.	77.9	79.4
Rhode Island	19 "	Fore River Shipbuilding Co.	82.5	84.
Connecticut	18 "	Navy Yard, New York, N. Y.	67.17	70.24
Louisiana	18 "	Newport News Co.	69.54	71.9
Vermont	18 "	Fore River Shipbuilding Co.	38.8	43.4
Kansas	18 "	New York Shipbuilding Co.	43.5	48.1
Minnesota	18 "	Newport News Co.	58.69	61.76
Mississippi	17 "	Wm. Cramp and Sons.	22.55	24.39
Idaho	17 "	Wm. Cramp and Sons.	19.98	22.27
New Hampshire	18 "	New York Shipbuilding Co.	0.0	1.5
ARMORED CRUISERS.				
West Virginia	22 knots.	Newport News Co.	99.75	99.95
California	22 "	Union Iron Works	72.2	73.5
Maryland	22 "	Newport News Co.	97.5	99.
South Dakota	22 "	Union Iron Works.	69.5	71.3
Tennessee.	22 "	William Cramp and Sons.	65.14	69.45
Washington	22 "	New York Shipbuilding Co.	66.4	70.2
North Carolina	22 "	Newport News Co	0.53	2.15
Montana	22 "	Newport News Co	0.55	2.01
SEMI-ARMORED CRUISERS.				
St. Louis	22 knots.	Neafie and Levy Co.	58.8	60.6
Milwaukee	22 "	Union Iron Works.	68.	69.8
Charleston	22 "	Newport News Co.	92.02	92.56
GUNBOATS.				
Dubuque	12 knots.	Gas Engine and Power Co.	88.2	90.9
Paducah	12 "	Gas Engine and Power Co.	78.6	82.8
TRAINING SHIPS.				
Cumberland	Sails.	Navy Yard, Boston.	94.	95.
Intrepid.	"	Navy Yard, Mare Island	86.	95.
TRAINING BRIG.				
Boxer	Sails.	Navy Yard, Portsmouth	98.	99.5
TORPEDO BOATS.				
Stringham	30 knots.	Harlan and Hollingsworth.	99.	99.
Goldsborough	30 "	Wolff and Zwicker.	99.	99.
Nicholson	26 "	Lewis Nixon.	99.	100.
O'Brien	26 "	Lewis Nixon	99.	99.



INBOARD PROFILE OF THE ROOSEVELT.


Forecastle Deck Beams
Main Deck Rail
Main Deck Beams
Under Side of Rail
Beam at L.W.L. (16' Mean Draft) at 76 Station = 33'
Note: Lines are drawn to outside of Plank
Under Side of Rail
Lead Water Line
Bottom of Keel
Rabbet of Plate
Sections Line
Top of Forecastle Deck Beams
Under Side of Rail (outside of plank)
Top of Main Deck Beams (outside of plank)
Lead Water Line
Top of Guard Strake
Top of Main Deck Beams at Side
Length on L.W.L. 101'
Section Line
Center Line of Vessel
Rabbet of Plank
C. of Shaft
Top of Main Deck Beams
Lead Water Line
Bottom of Keel
Propeller Well
Rudder Well
Marine Engineering

LINES OF THE ROOSEVELT.

THE STABILITY CALCULATION FOR A MODERN SAILING YACHT.

Any extended discussion of the theory of approximate integration for volumes, or for finding centers of buoyancy, or of the theory of stability, is obviously out of the question in the limited space available. In this discussion we must, therefore, assume a general acquaintance with the usual methods for the determination of displacement, centers of buoyancy, and stability, and from this point of departure develop such modifications or special applications as are best suited to the treatment of the case in hand.

We first assume the half breadth and body plans at hand, the former showing the water-lines, the latter the sections. Volume or displacement alone may be found with equal readiness from either plan, while the half-breadth plan has advantages for the determination of centers of buoyancy, and the body plan for stability. The mode of procedure will depend primarily on whether a planimeter is at hand or the work must be done by means of ordinates. The chief point of difference between the case of a sailing yacht and a ship of the normal form lies in the fact that in the former the water-lines are for the most part all of different lengths, while in the latter they are for the most part of the same length. While this fact introduces some complication into the use of ordinates it makes no difference whatever with the use of the planimeter, and we may therefore proceed in the regular way for volumes and centers. The point of first attack will be the area of the water-lines. If the planimeter is of the rolling type this may be done by a single operation on each water-line as given on the half-breadth plan. If, however, the planimeter is of the polar type it will presumably be impossible to take in an entire water-line area at one operation. In such case two ways are open:

(1) The water-line areas may be taken in parts, including as great a length each time as the instrument will allow, and then summing the results.

(2) The water-lines may be redrawn, shortened up in length, and, if desired, broadened out in width. Such a distorted water-line is shown in Fig. 1. This is simply a representation of the water-line with different scales in the two directions, fore and aft and transversely. In this manner the entire half-breadth plan may be redrawn in such shape as to permit of treatment by the planimeter, each water-line at a single operation with the planimeter.

A word at this point regarding scales and the transformation of the planimeter readings with actual areas may be of use.

As a rule it will be preferable to set the planimeter so that the readings will be in square inches of area on the drawing board.

Let a be the area read from the instrument in square inches.

Let A be the corresponding actual area on the boat.

Suppose the drawing first to the same scale in both directions and $\frac{1}{n}$ inch to the foot, or 1 inch $= n$ feet.

Then we shall have:

$$A = n^2\, a.$$

Thus if $a = 8.23$ square inches, and the scale is 1-4 inch to the foot, then $A = 16 \times 8.23 = 131.68$ square feet.

Again, suppose the water-lines are distorted by shortening up and widening out, so as to make possible the circuit of the entire area at one operation by the planimeter.

Let the scale fore and aft be $\frac{1}{h}$ inch $= 1$ foot, and transversely $\frac{1}{k}$ inch $= 1$ foot; or 1 inch $= h$ feet fore and aft, and k feet transversely. Then if a = area read by planimeter, and A = area on boat, we have:

$$A = h\, k\, a.$$

Thus, if the scale fore and aft is 1 inch $= 16$ feet, and transversely 1 inch $= 2$ feet, and if $a = 11.2$ square inches, then $A = 2 \times 16 \times 11.2 = 358.4$ square feet.

In this manner then we may find the areas of the successive half water-lines from the bottom of the keel upward to the successive immersions or drafts, and quite independently of their varying lengths and of the difficulty of treating such a case by the use of ordinates by the usual rules.

Then multiply each of these areas by 2, and plot as in Fig. 2, giving a curve of full water-plane areas. Then proceed with the planimeter to measure the area between the curve and the axis OY up to any water-plane, as YB, marking the deep load-line or the deepest draft for which the displacement is desired. Lay off the result to any convenient scale as an ordinate YB. Then find similarly the areas up to a series of water-lines 17, 16, 15, etc., down to 3 or 4, below which the values will be of no ultimate use. All such areas are then to be laid off as ordinates to the same scale as YB, and each on its own water-line, thus giving the curve OB as shown. This will be a curve of volumes and it will be only necessary to multiply any ordinate of this curve by a suitable factor in order to find the corresponding displacement.

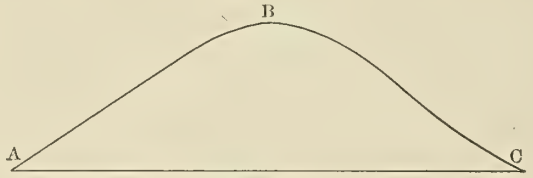


Fig. 1

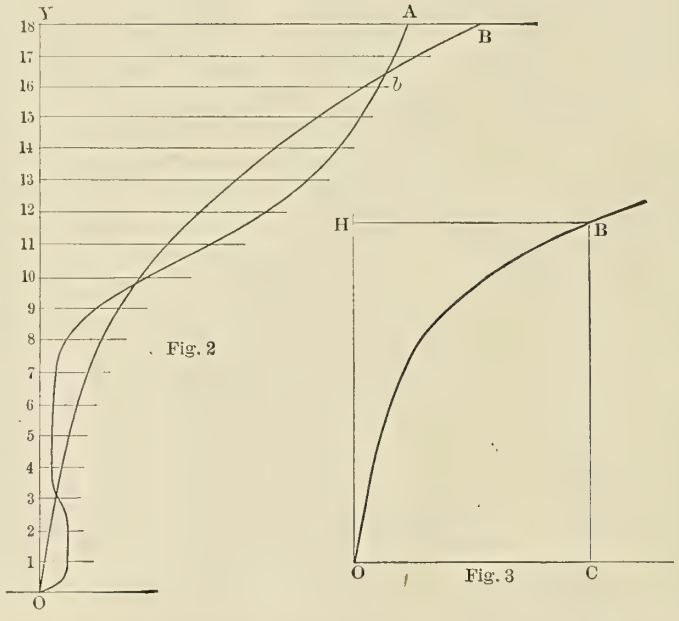


Fig. 2 Fig. 3

This factor is found as follows: Suppose the scale for laying off the ordinates for the curve OA representing water-line areas is 1 inch $= h$ square feet, and let the vertical scale be 1 inch $= k$ feet. Then 1 inch of area of OYA will represent hk cubic feet of the boat. To find the displacement we have therefore the following rules:

Let a = any area on diagram, OYA = corresponding ordinate of curve OB.

h = scale for plotting OA.

k = " " draft laid off on OY.

Then hka = cubic feet of displacement of boat, and $hka \div 35$ = displacement in tons of sea water.

Thus suppose OA plotted to a horizontal scale of 1 inch $= 100$ square feet, while the scale for draft on OY is 1 inch $= 4$ feet. Then let the area up to any given water-line as O 16 b measured by the planimeter be 2.3 square inches. The corresponding displacement volume will be $100 \times 4 \times 2.3 = 920$ cubic feet, and displacement $= 920 \div 35 = 26.3$ tons.

In this manner then the displacement to any water-line may be found, and the complete displacement curve plotted. The first

item of the required information is thus complete. We next proceed with the centers of buoyancy.

In Fig. 3 let *OB* represent either the displacement curve or the curve *OB* of Fig. 2, plotted as above explained, and let *OH* be any draft at which the center of buoyancy is desired, and *HB* the horizontal representing the corresponding water-line. Then the distance of the center of buoyancy above the base *OC* will equal the average vertical height of the area *OBC*. To find this, simply measure the area *OBC* by planimeter, in square inches, and divide by the length of *OC* in inches. Then reduce the quotient to feet by the scale used on *OH*. Thus, for example, let the scale on *OH* be 1 inch = 4 feet, and let the draft be 10 feet. Then *OH* = 2.5 inches. Then let the area *OBC* measured by planimeter be 4.8 square inches, and *OC* be 3 inches. Then the average vertical ordinate of *OBC* = 4.8 ÷ 3 = 1.6 inches, and

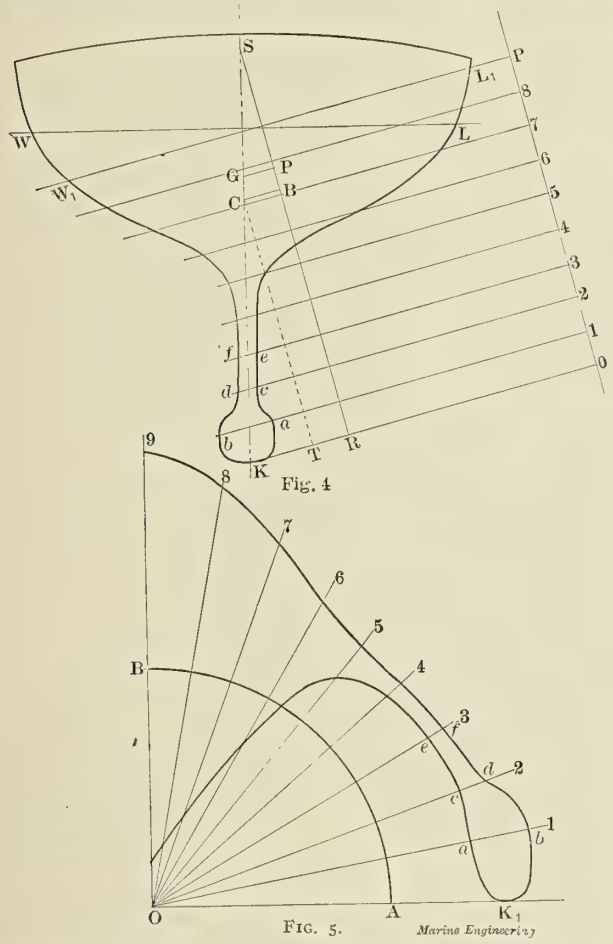


Fig. 4

Fig. 5. *Marine Engineering*

this reduced to feet on the boat gives 4 × 1.6 = 6.4 feet. Hence for immersion to the 10-foot water-line the center of buoyancy will be 6.4 feet above *OC*, the bottom of the keel. In a similar manner the center of buoyancy for any other immersion may be found, and a curve of centers of buoyancy plotted in the usual manner if desired.

This short and simple manner of finding the center of buoyancy, having given the displacement curve, is not perhaps as generally known as its simplicity and rapidity in operation merit. In principle it is exact and not merely approximate. The mathematical proof would require more space than can be here allowed.

With regard to stability there are methods, almost legion in number, some with and some without instrumental aid. If an integrator giving both area and moment of section is at hand, the process becomes relatively short and simple. We shall not assume, however, the use of instrumental aid to this extent, but will first describe a method by the use of the planimeter. We assume further that the stability may be desired for any displacement close about the normal load value, either more or less. Then we may describe the operations in the following steps:

(1) Redraw the body plan with complete sections, preferably, perhaps, the fore and after bodies separate to avoid confusion.

(2) Assume a water-line making the desired angle of inclination with the load water-line, and, as nearly as judgment may determine, cutting off a displacement slightly greater than that cut off by the load water-line.

(3) In Fig. 4 is shown for simplicity a single section with the load water-line *WL* and the inclined water-line W_1L_1. Then the whole problem of stability consists in finding the statical moments of a series of such sections about some fixed axis *OP* perpendicular to W_1L_1.

(4) Draw *KO* parallel to W_1L_1 and just tangent to the bottom of the section at *K*.

(5) Divide *PO* into any convenient or desired number of equal parts, say 9, and draw lines 1 *b*, 2 *d*, 3 *f*, etc.

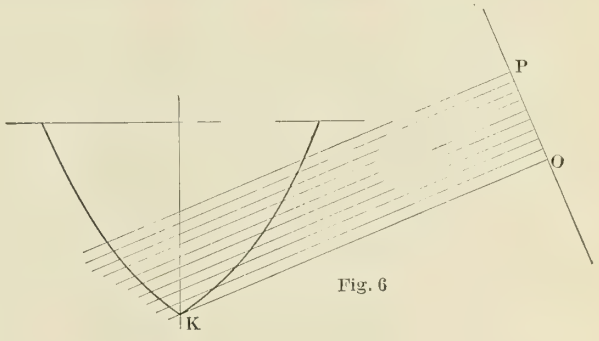


Fig. 6

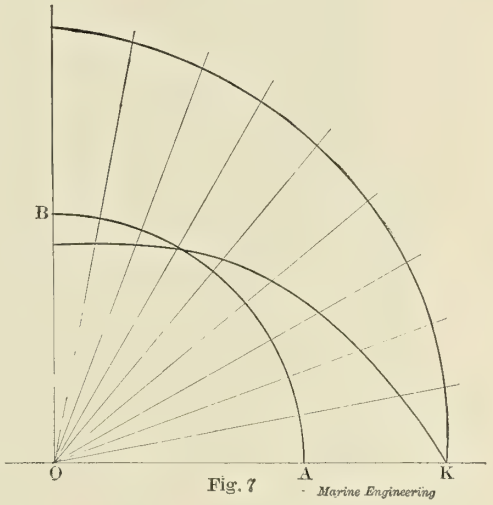


Fig. 7 *Marine Engineering*

(6) Lay off a right angle and quadrant *AB*, Fig. 5, and divide into 10-degree intervals, drawing radial lines as shown. Then there will be 9 intervals corresponding to the 9 divisions of *OP*, Fig. 4. In any case, whatever the number may be, it should be the same for the distance *OP*, Fig. 4, and for the quadrant of Fig. 5.

(7) Transform the section KW_1L_1, Fig. 4, into that shown in Fig. 5 by laying off OK_1, Fig. 5, = *OK*, Fig. 4, and *Oa*, *Ob*, *Oc*, *Od*, etc., Fig. 5, respectively equal to 1 *a*, 1 *b*, 2 *c*, 2 *d*, etc., Fig. 4. The section of Fig. 4 will thus be transformed as shown into that of Fig. 5.

For the smaller sections near the ends, where the under-water body rises toward the surface and the depth of the section is but slight, as in Fig. 6, a smaller number of subdivisions will answer if desired, but in any case there will be an advantage in using the same angle of, say, 90 degrees in each case. In this case the transformed section is shown in Fig. 7.

(8) Take the area of the section of Fig. 5 by planimeter, noting the result in square inches.

(9) Multiply the area as found in (8) by the length *OP*, Fig. 4,

in inches, and the product will be proportional to the moment of the section of Fig. 4 about *OP*.

(10) Measure with the planimeter the area of the section of Fig. 4, also in square inches.

(11) Repeat the operations (4) to (10) for the series of sections throughout the length of the boat.

(12) Plot these values for moment and area on an axis of fore and aft length, the one giving a curve of sectional areas for the water-line W_1L_1, and the other a curve of statical moments of these sections about an axis *OP*. In running these curves out to zero at the ends aid may be obtained by noting on the body plan the approximate location between the sections at which the under-water body cut off by the inclined water-plane will run out to nothing. Such curves are shown in Figs. 8 and 9. In plotting these curves care must be exercised in the selection of scales to the end that the diagrams may result of size suited to the planimeter.

(13) Find by planimeter the areas of these curves, each in square inches, and divide the result for the moment curve by that for the area curve.

(14) Let the various scales be as follows:

For the sections such as Figs. 4 and 6, 1 inch $= n$ feet.

For the ordinates of the section area curve, Fig. 8, 1 inch $= p$ square inches.

For the ordinates of the section moment curve, Fig. 9, 1 inch $= q$ units as found in (9).

For the lengths of Figs. 8 and 9, 1 inch $= s$ feet.

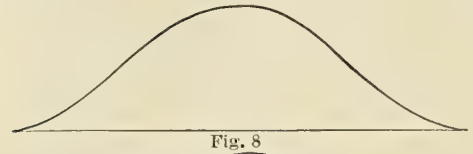


Fig. 8

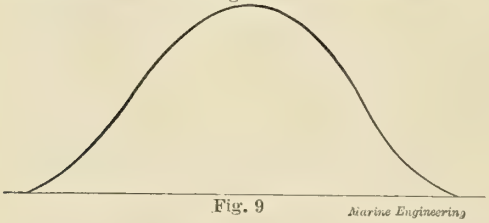


Fig. 9 *Marine Engineering*

Then multiply the quotient found in (13) by $2\,nq \div \pi p$, and the result will be the moment arm for the volume of displacement cut off by the inclined water-plane, and with reference to the axis *OP*.

(15) Lay off this arm to scale on the body plan as shown at *OR*, Fig. 4, and draw *RS* parallel to *OP*.

(16) Multiply the area of the curve of section areas as found in (14) by n^2ps and divide by 35. The result will be the displacement cut off by the water-line W_1L_1, in tons of sea water.

(17) For this displacement find from the previous computations the corresponding height of the center of buoyancy, and suppose it represented by *C*, Fig. 4. Then *CB* = the surface stability arm, and if the center of gravity of the boat is located as at *G*, then *GP* = the stability arm sought.

(18) The arm $CB = OK - OR - KC \sin \theta$, and all of these are known quantities found as above.

(19) Then $GP = CB - CG \sin \theta$, and this becomes known if the location of *G* is known.

(20) The product of *CB* or *GP* by the tons of displacement will give respectively the surface and actual stability in foot tons.

In a precisely similar manner the stability for any other angle or location of inclined water-line may be found. In order to make the investigation reasonably complete it will be necessary to carry through two series for the varying angles, one somewhat above the normal load displacement and the other somewhat below. In the details of the work many points may be seen where, by suitable dispositions, time and labor may be saved. The main outline only of the operations is given here.

(21) Having thus found the stability arms for two series of values of the angle of inclination, we may find the arm for any intermediate value of the displacement by simple interpolation between the values thus determined. Suppose, for example, that the normal load displacement is 80 tons, and that the stability arm at an angle of 30 degrees is desired. Let the two computations for 30 degrees result as follows:

Upper displacement 83 tons, stability arm 2.1 feet.

Lower displacement 78 tons, stability arm 2.2 feet.

Then $83 - 78 = 5$, and $80 - 78 = 2$. Hence the load displacement lies 2-5 the way between 78 and 83 and we take the arm correspondingly 2-5 the way between 2.2 and 2.1 or 2.16.

If in any case the displacement for a trial water-plane results too far from the mean load value, a second trial may be necessary.

The above series of operations will therefore serve to determine the stability for any proposed condition, and the third item is thus completely determined.

In a later issue some further discussion may be given regarding the determination of these same items by the use of ordinates.

W. F. D.

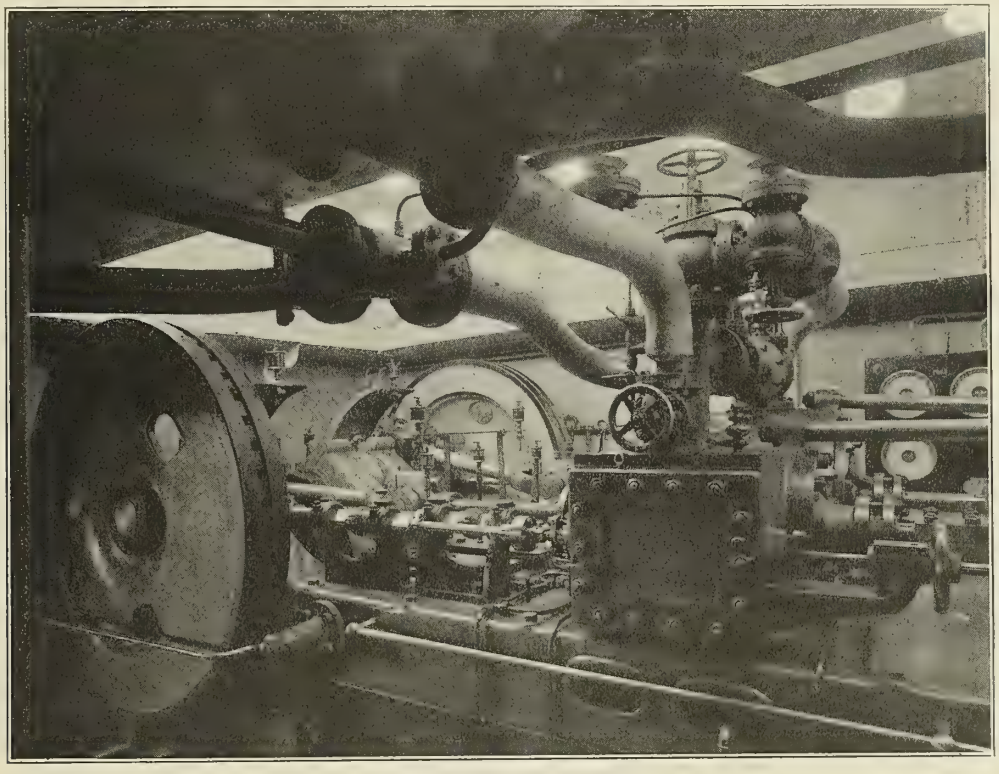
A SWISS LATEEN-RIGGED SAILING VESSEL.

A Form of Boat Used on Lake Geneva, Switzerland.

The illustration shows a peculiar type of sailing vessel used on Lake Geneva, for the purpose of carrying stone, sand, gravel, and wood, for building purposes at the French end of the lake. The rig consists of two lateen sails shaped very much like those in use on the Nile and certain parts of the southern shore of the Mediterranean Sea. The boats vary in length from 80 to 100 feet, and are about 25 feet wide. They are built of oak or elm, and the masts are made of either larch or fir.

REFRIGERATING PLANTS ON NEW UNITED FRUIT COMPANY STEAMERS.

The three large steamers recently added to the United Fruit Company's fleet of steamships, and specially designed and fitted for the carriage of bananas, were built at Messrs. Workman, Clark & Company's shipyards, Belfast, Ireland, and were launched in order named: the *San Jose*,* the *Limon*, and the *Esparta*. These ships are practically built to the same model, although the last two ships are deeper in the decks. The dimensions are 343 feet by 44 feet 3 inches by 31 feet 3 inches. They have three steel decks extending the full length of the vessel, and the cargo spaces are divided into separate compartments by steel water-tight bulkheads extending to the upper deck. They have four insulated deck spaces forward, and three insulated deck spaces aft. All of the spaces are insulated with tongued and grooved boarding and cow-hair felt. The carrying capacity of each boat is from 45,000 to 50,000 bunches of bananas, and the net insulated space is about 140,000 cubic feet.



THE COMPRESSING ENGINES.

The main engines were constructed at Messrs. Workman, Clark & Company's engine works, and consist of a set of triple-expansion engines supplied with steam from three steel boilers working with the Howden's system of forced draft.

Each ship is fitted with refrigerating machinery installed by the American Linde Refrigeration Company, of New York, which company also fitted up the steamship *Venus*, another of the United Fruit Company's fleet. Upon this steamer a large number of experiments were made and valuable information collected, which was used to the fullest advantage in fitting up the three ships we are describing.

The refrigerating machinery is carried upon the upper deck in a separate compartment of the aft end of the steel deck-house. Immediately forward of it is a compartment containing the Linde air cooler, cooling the after end of the vessel. Another air cooler is contained in a compartment near the forward end of the same deck house, and controls the temperatures of the forward end of the vessel.

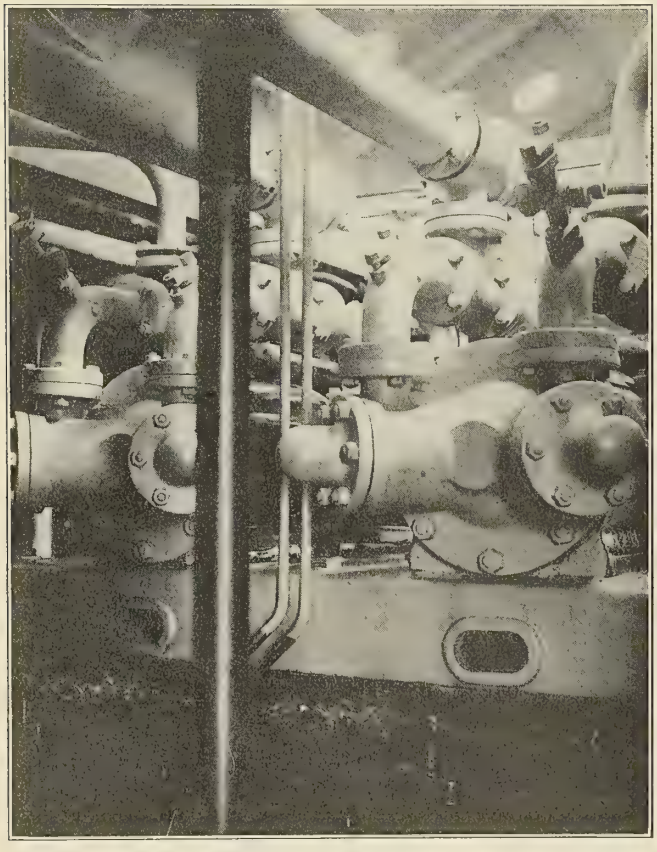
The refrigerating plant consists of one of the duplex marine type plants, having two double-acting ammonia compressors placed tandem to a compound steam engine, each compressor being driven by the prolongation of the steam piston rod, which is connected to the compressor piston rod by a removable and adjustable coupling. The machine is self-contained upon a massive cast-iron bed-plate, which is carried by a heavy steel tank bed-plate containing the ammonia condenser coils. The crank shaft is built up in two lengths, with a flange coupling between them, so that in the case of a breakdown of one of the two compressors the other can be run at full speed in order to fulfill the duty required. The steam connections to the compound steam cylinders are so designed that they may be run compound, or either may be run at high pressure, as required. The machine is designed for a working steam pressure of 160 pounds per square inch, and when at sea the exhaust is carried to the main engine condenser. There are two brine coolers, each connected to one compressor, but with the connections so arranged that either or both may be run to either or both of the compressors, or *vice versa*. These brine coolers consist of a heavy cylindrical wrought-iron tank provided with heavy water-tight cover so arranged as to admit of the evaporator coil being readily removed. Each tank contains a nest of six circular coils of extra heavy 1 1-4-inch piping, through which the ammonia is expanded for cooling the brine. The tanks are provided with automatic gas vents to pass off any gas that may be generated, and are also provided with suitable gauge glass fittings, which are taken through the insulation in order that the engineer can readily ascertain the quantity of brine the system contains. The coils pass through stuffing boxes contained in the tank, and the ends are connected with suitable headers for the distribution of the liquid and the collection of the gas. The amount of liquid passed through each coil can be regulated by a small valve.

There are two brine circulating pumps of the centrifugal type, each coupled to a vertical high-pressure steam engine. The pumps are connected to the refrigerator tanks by cross-over connections that admit of either or both of the pumps working on either or both of the refrigerators. These pumps were specially designed for the duty, and were manufactured by the Kingsford Foundry &

* Described on page 487 of Marine Engineering for October, 1904.

Machine Company. The pumps are brass fitted throughout, and so constructed as to stand continuous day and night wear, and to perform the duty at a very low speed. These pumps are placed against the side of the deck house immediately behind the end of the compression cylinders, and are separted from the refrigerators by an insulated bulkhead which also insulates the after air cooler.

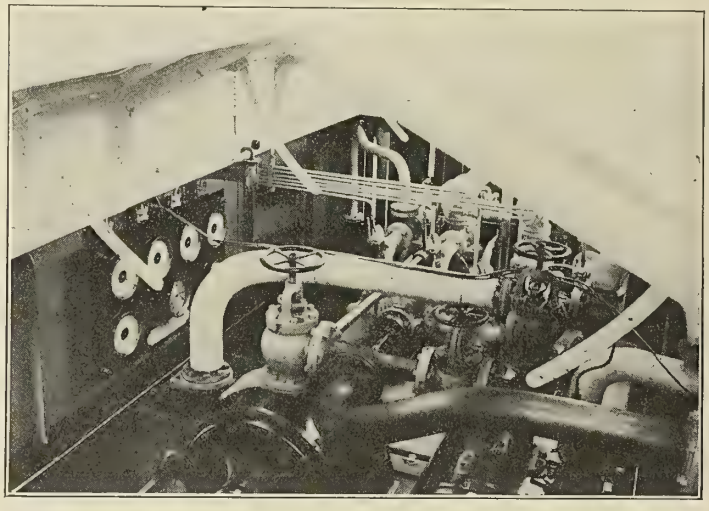
The water circulating pumps for the ammonia condenser are in duplicate, and are of the centrifugal type, direct-connected to a vertical steam engine, and are of similar design to the brine circulating pumps. These water circulating pumps are placed in the main engine room, and force the circulating water through the ammonia condenser tank, which has arrangements to insure a proper and even circulation. At one side of the refrigerating engine room are two direct steam-driven centrifugal brine spray pumps. These pumps circulate the cold brine, and send this solution in the form of spray over the coils in the air coolers, so as to increase their efficiency and clear the air from any impurities which it may contain.



AMMONIA CYLINDERS.

The two air coolers have been carefully designed to meet the special requirements of the United Fruit Company, who have had unique experience in the carrying of perishable fruit cargoes in general, and of bananas in particular. Provision has been made so that not only can the volume and the temperature of the air discharged be adjusted, but as far as possible, the humidity can be modified from what would be the normal saturation point corresponding to its temperature. A point of vital importance is the maintenance of large volumes of air in as dry a state as possible for certain periods, and this has been most carefully provided for. Each cooler is provided with a large fan, specially built for the work, which is direct-driven by a vertical steam engine, and is designed for continuous day and night running. These fans were constructed by the Sirocco Engineering Company. They are of the heavy steel plate, cased construction with double intakes, and will furnish the necessary volume against a water pressure of 3 or 4 inches. This duty is performed when running at a speed of about 350 revolutions per minute.

The air circulation and the arrangement of the air trunks for the delivery of the cold air into the insulated chambers and the suction ducts back to the coolers, have been very carefully considered and studied. The question of uniform and sufficient distribution of suitably cooled air necessary for the proper preservation of this most delicate fruit, has always been one of great difficulty, and special care has been given to this part of the work in order to eliminate, as far as possible, the bad results attendant upon imperfect air circulation. In this matter the engineers have been guided to a large extent by the information obtained from actual experiments conducted on the steamship *Venus,* which, as before mentioned, was fitted up with a plant upon similar lines, and has been running in the same trade for over a year. The air trunks and ducts have been designed to give the maximum amount of efficiency with the minimum amount of space, or, in other words, the fruit carrying capacity has been reduced as little as possible. The decks of the insulated chambers are provided, as usual, with gratings. The suction air trunks are arranged overhead in such a manner that no storage space is lost. For the cold air delivery ducts the spaces between the reverse frames have been utilized in an ingenious manner, and these chutes or ducts are so subdivided that the proper proportionate amount of cold air is introduced into the fruit spaces in certain points or stages, so that an even distribution, which is of the utmost importance, is obtained.



THE DUPLEX PUMPS ON ESPARTA.

The air chutes are provided with small slides, so as to regulate the amount of air withdrawn from the chambers. There are also traps for cutting off the main chutes to each of the separate chambers, and a simple arrangement is embodied in the air chutes by means of which the air currents can be crossed over; in other words the air can be introduced into the top or bottom of the chamber at will. There are also connections by means of which fresh air from the atmosphere is circulated over the coolers and into the fruit chambers, and also the air in the cold chambers discharged overboard.

We may mention that these plants are provided with an appliance by which the insulated spaces may be raised in temperature as required, by the circulation of air gradually heated by the brine circulation being warmed up by a steam heater. This has been found necessary to guard against the chilling effect of the winter season in the home ports. By this means the temperature of the fruit at the port of discharge can be regulated at will to suit the requirements of the port and market.

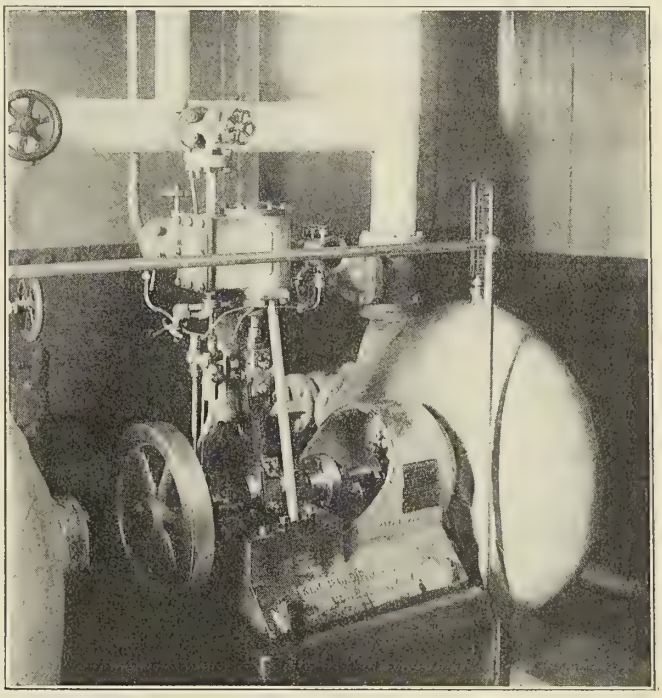
The temperatures are read by thermometers hanging within thermometer tubes, all passing to the upper deck, and fitted with screwed brass caps. That the air circulation and temperatures are uniform is proved by the thermometer readings, it being found that the variation throughout the whole of the insulated

space does not vary more than about 1 1-2 degree Fahrenheit. These thermometers are of a specially sensitive type, supplied by the Hohman & Maurer Manufacturing Company, who also constructed the special transmission thermometers by which the reading of the various air temperatures are taken upon the outside of the insulated compartments.

The actual cooling is effected by the vaporization of liquid ammonia generated in the condenser coils by the combination of the pressure obtained by compression and the cooling effect exerted by the condensing water. The liquid is vaporized in the coils of the brine coolers, thus reducing the temperature of the brine, and the ammonia vapors are then drawn by the compressor and forced into the condenser, thus completing the cycle of operation.

The air coolers consist of vertical sheets of iron piping with the necessary headers and regulating valves, through which the cold brine is continually circulated by the centrifugal pumps before described. The warm air from the cold chambers is drawn out by the fans, forced over the outside surfaces of these cold brine pipes,

THE COMPRESSORS.



BRINE-CIRCULATING PUMP.

and is discharged into the cold chambers in a continuous circulation. The two small spray pumps before referred to pass a certain quantity of cold brine solution over the outside of the coils in the form of a spray. This spraying arrangement is divided into sections in a special manner, so that any number of sprays may be used as found necessary, and quantity of cold brine spray delivered can be regulated, or completely shut down.

This circulation of the cold brine over the exterior surface of the air cooler coils has several advantages. The air drawn from the cold chambers in which are stored large quantities of freshly loaded fruit is naturally at the earlier stages in a more or less impure condition, and contains a large amount of foreign matter in suspension, which is separated by the cold brine sprays and caught and collected in the tank containing the air cooler coils. The air is also sweetened and purified, and, in addition, the coil surface is rendered more active, and greater efficiency obtained. On a long voyage the air in the cold chamber is gradually cleared of the carbonic acid given off by the fruit, and otherwise purified by the process of cooling, and the duty required of the spray pumps is gradually decreased, so that after a number of days of continuous work the spray pumps can be shut down.

The air cooler tank is provided also with an arrangement of baffle plates by means of which the spray is prevented from being carried over by the air, and the moisture which is taken from the fruit is automatically collected and discharged overboard. A number of trays are also provided for the reception of chloride of calcium in a dry state, should extra dryness of the cold air be required.

It will readily be understood that the carriage of delicate, perishable fruit is a matter requiring a large amount of skill and attention, and the satisfactory carriage of refrigerated bananas upon a long voyage, a considerable portion of which is under tropical conditions, requires great care. Many things have to be considered, such as the grade and age of the fruit, length of voyage, atmospheric conditions under which the fruit was loaded, climatic conditions affecting the plantation from which the fruit was obtained, atmospheric conditions during the voyage, method of storage, and the requirements of the market at the discharge port. All of these conditions affect the determination of the volume, state of humidity, temperature of air to be circulated, and the temperatures to be maintained within the cold storage spaces, and likewise the amount of fresh air to be drawn from the atmosphere and circulated over the fruit.

These ships were intended for the banana trade between Port Limon and Boston, but have recently been running from Port Limon to New Orleans. The bananas are loaded in the ship at Port Limon by two endless conveyors, one working upon the forward end and one upon the after end of the ship. These conveyors receive the fruit on the wharf and deliver it on the upper deck immediately over the hatchways. Each machine is driven by a steam engine and the fruit is conveyed upon a wide, endless belt, the top or delivery side of which is forced into a V or trough section by means of jockey pulleys arranged at a proper angle. The delivery end of the machine is made fast to the ship, but the feeding end, which carries the driving gear and steam engine, is mounted upon a strong foundation plate fitted with rollers, so that the movement of the machine caused by the riding of the ship can be taken up. The machine is supplied with steam through a flexible hose from the winch pipe on the ship's deck.

The fruit is unloaded at New Orleans by a machine invented, we believe, by Mr. G. J. Edelston, one of the engineers of the United Fruit Company, and erected by the Harris & Edelston Conveyor Company. This machine is capable of meeting the requirements of any size of ship, and has been very successful. It

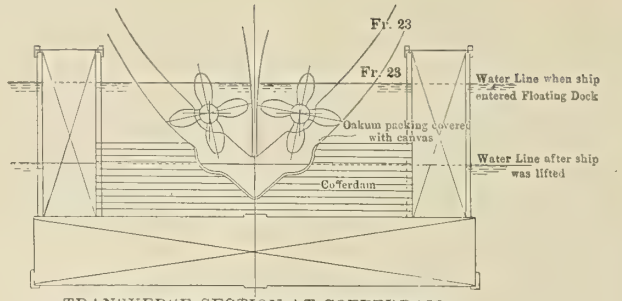
has a vertical section swinging upon an auxiliary boom, which may be regulated to suit the beam of the ship. This vertical section is lowered into the ship's hatchway, and is fed from all the deck spaces simultaneously. The bunches of bananas are then lifted by an endless belt in a vertical direction over the top of the machine, and conveyed downward into the railway sheds, and are finally delivered by a horizontal length upon a table close to the refrigerator railway cars. This is an endless belt arrangement over a number of horizontal roller bars, the belting being slack, and so naturally forming a kind of a hammock or bag, and owing to this particular construction the fruit sustains no violent shock at any point of its transit. The machine is driven by two electric motors, and is self-contained and mounted upon a strong bed plate. It has a transverse travel along the rails upon the wharf, so as to be brought into proper position with respect to the ship. Two of these machines are said to be capable of unloading 50,000 bunches of bananas in about eight hours.

These three ships have been thoroughly tried out and tested under all conditions. They have been made to consume twelve days on a nominal five- or six-day trip, and have anchored in tropical seas with fresh cargoes aboard, in order to put the refrigerating machinery to the severest test possible. The *San Jose* has been in commission since August 3, 1904, the *Limon* since September 21, 1904, and the *Esparta* since October 26, 1904. The plants have given excellent results, and represent the most recent practice of this particular branch of refrigeration.

Repairs to the Steamship Shawmut.

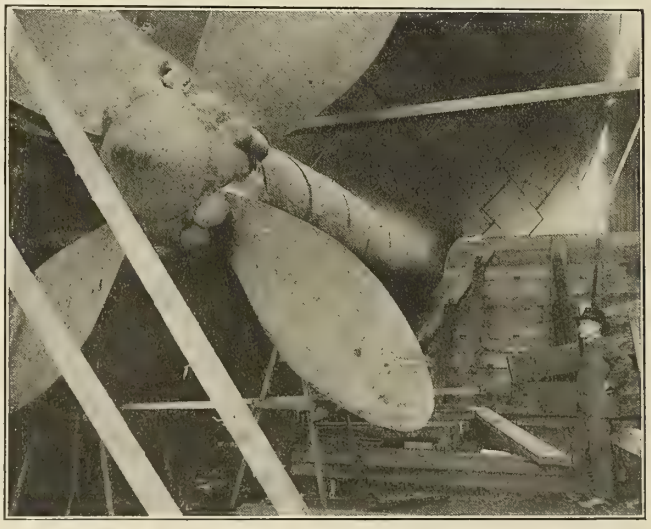
Due to the fact that the United States government imposed excessive docking rates for the use of the dry-dock at Bremerton, in the Puget Sound navy yard, the Moran Brothers' Company, of Seattle, Wash., were driven to a very ingenious and decidedly novel expedient in making repairs to the steamship *Shawmut** of the Boston Steamship Company. The *Shawmut* is a ship about 500 feet long and of 9,606 tons, and the figure first quoted by the government for the use of the dock for the estimated required time of twenty-one days, was $21,133.20. Upon application through Hon. W. E. Humphrey, congressman from Washington, this figure was ultimately reduced to $15,527.20, against which the British dock at Esquimalt, British Columbia, offered a charge of $5,042.40.

The Moran Brothers had determined, however, not to allow the repairs to go to a Canadian firm, and they therefore prepared



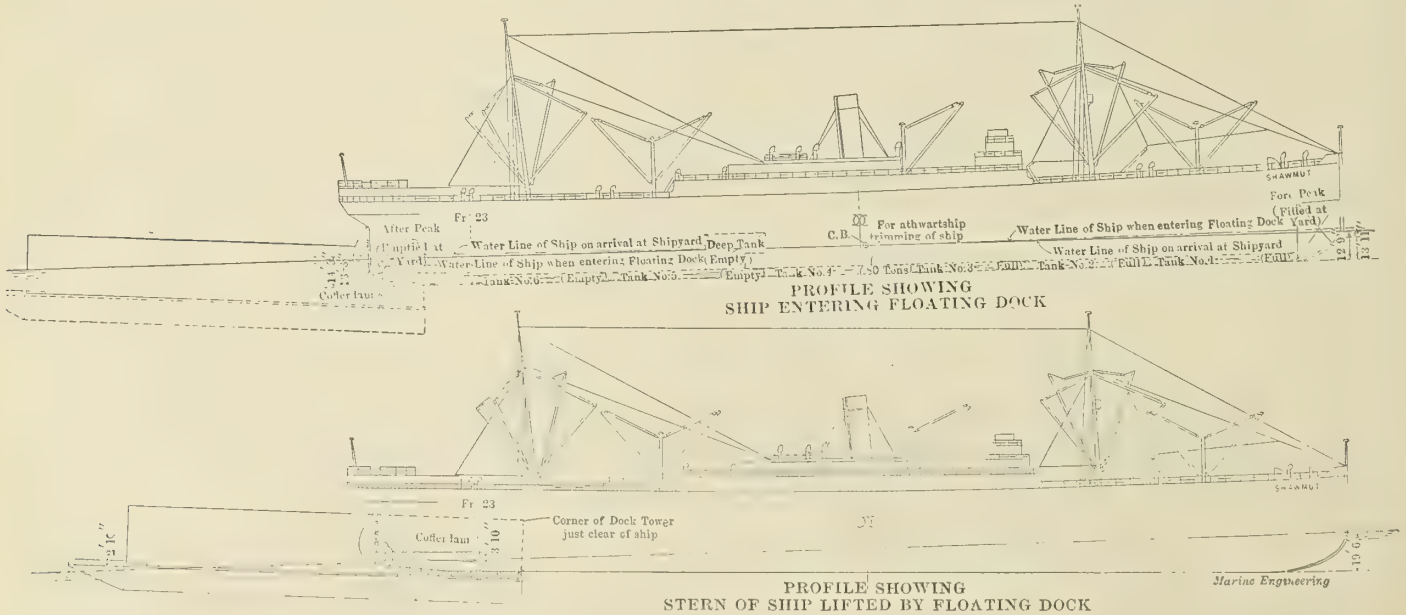
TRANSVERSE SECTION AT COFFERDAM SHOWING STERN OF SHIP ENTERING FLOATING DOCK *Marine Engineering*

to make use of their own floating dry-dock, which has a length of only 200 feet and a maximum lifting capacity of 2,700 tons. The *Shawmut* went aground in Chinese waters, and sustained a double fracture in her stern frame, but managed to reach Puget Sound before the repairs were made. The fact of the accident, however, was reported by cable to the home office, and a new stern frame steel casting was ordered from the shops of the builders, the Maryland Steel Company, of Sparrow's Point, Baltimore, and this was shipped to Seattle in time to be worked into the vessel on her arrival there. The illustrations which we give show that when the stern of the vessel was placed in the dock the



VIEW OF THE COFFERDAM AND STARBOARD PROPELLER.

*Described and illustrated on page 1, Marine Engineering, January, 1902.

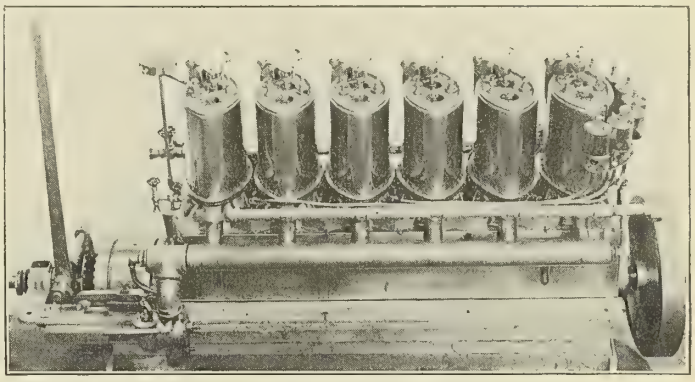

Fr 23
After Peak
Water Line of Ship on arrival at Shipyard
Deep Tank
C.B.
For athwartship trimming of ship
Water Line of Ship when entering Floating Dock Yard)
Water Line of Ship when entering Floating Dock Empty)
Water Line of Ship on arrival at Shipyard
Tank No.6 (Empty)
Tank No.5 (Empty)
Tank No.4
750 Tons
Tank No.3 (Full)
Tank No.2 (Full)
Tank No.1 (Full)
Coffer Dam
PROFILE SHOWING SHIP ENTERING FLOATING DOCK
Fr 23
Corner of Dock Tower just clear of ship
Coffer Dam
PROFILE SHOWING STERN OF SHIP LIFTED BY FLOATING DOCK
Marine Engineering

clearance between the side of the ship at frame 23 and the corners of the wings of the dock was only a fraction of an inch, while the dock itself, having insufficient lifting capacity to raise the stern entirely out of water for the purpose of making the repairs, was fitted with a cofferdam, modeled to the form of the stern of the ship and calked in order to make it water-tight, after the ship was placed in position. This having been done the water in the dock back of the cofferdam was pumped out, and the stern of the ship thus laid dry for the purpose intended. Our two photographs show the general character of the work done, as well as illustrate the cofferdam used as above.

GENERAL VIEW OF THE REPAIR JOB ON THE SHAWMUT.

A New 26-Mile Auto-Boat.

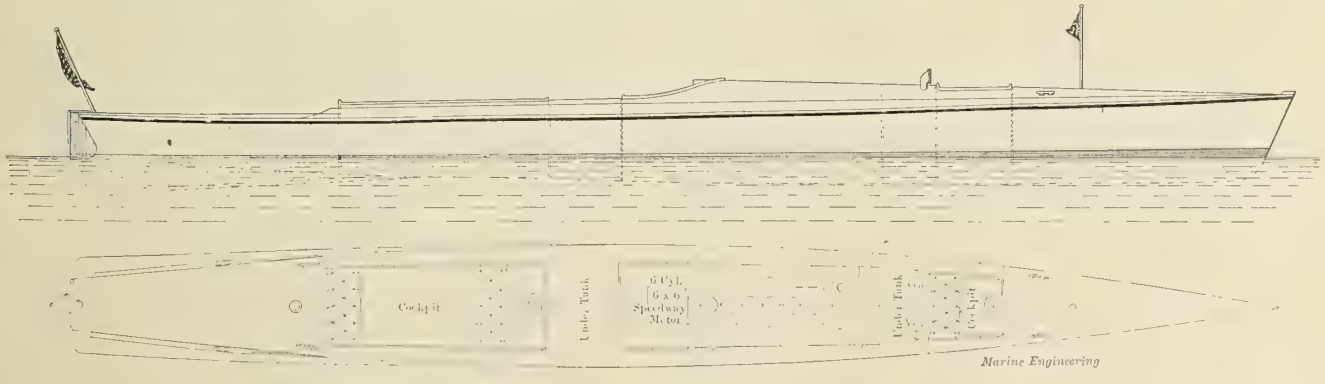
The accompanying design shows the general arrangement of a new 45-foot speed launch now building at the Morris Heights works of the Gas Engine & Power Company and Charles L. Seabury & Company, Consolidated, to the order of E. J. Schroeder, of Jersey City. This new motor boat is 45 feet long and of attractive model. The planking is double, of white cedar, with frames of oak, and inside double girders to give stiffness to the hull and to carry the motor. A hooded or "turtle-back" deck will cover the forward portion of the craft, giving protection to the machinery. The passenger cockpit only will be open. The steersman's cockpit forward of the motor will be used when the weather permits, and at other times will be covered with a hood. The finish of the decks and cockpits will be of Spanish cedar, polished and varnished. The motive power will be a six-cylinder,



60 horsepower "Speedway" engine of the latest auto-marine type, and the speed expected by the builders is 26 miles per hour. The boat will be delivered on or about the 15th of May, and will be entered in the motor-boat races of the coming season. During the season of 1904, the owner had in service the 40-foot "Speedway" auto-boat *Japansky,* the winner of the Manhasset Bay Yacht Club race for boats of her class on Memorial Day of that year.

The Oyster Boat Stranger.

There was recently launched from the shipyard of J. S. Ellis & Son, Tottenville, N. Y., the oyster boat *Stranger,* for the owners, Ockers & Company, New Haven, Conn. This is one of the largest and best-equipped oyster boats in the business. The boat is 72 feet over all, 21 feet 6 inches beam, 5 feet 6 inches depth, 5 feet draft, 40 tons gross, 35 tons net, and has a capacity of 2,500 bushels of oysters. She makes an average speed of 10 miles an hour, and is fitted as a dredging boat. She is equipped with "automatic" gasoline engines of 60 H. P., manufactured by the Automatic Machine Company of Bridgeport, Conn. There are three independent cylinders, operating four-cycle, each having its own independent valve motion, so that each cylinder is a complete engine in itself. This makes it very convenient to get at for adjustment and repairs. In case of necessity one cylinder can be cut out and the engine run on the other two. The crank shaft is a massive steel forging in one solid piece. The reversing gears are of forged steel bushed with bronze and run on hardened steel pins. One great advantage of an engine of this design is that the pistons can be removed without disturbing any of the piping, valves, or igniters, the cylinder heads being light and readily removed. The reversing clutch is secured to the engine by a flange coupling at the after main bearing; by removing

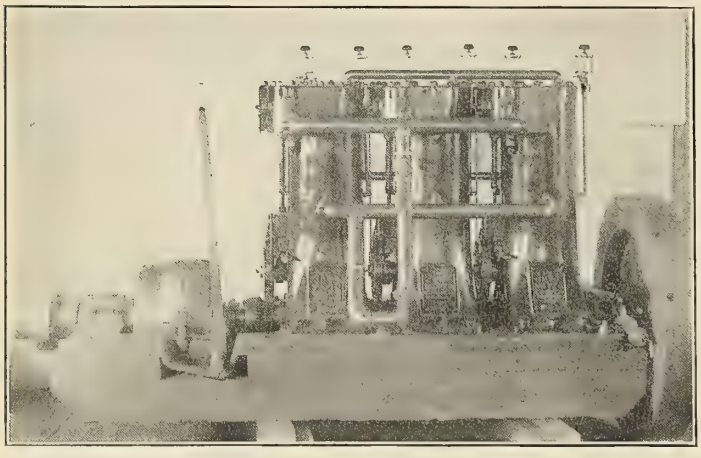


NEW SPEED LAUNCH FOR MR. E. J. SCHROEDER.

THE OYSTER BOAT STRANGER.

bolts from this coupling and the propeller coupling the gear can be lifted out intact. The thrust is taken up in the after bearing by a steel shaft with numerous collars turned from the solid metal and run in a high-grade babbitt bearing. The bearings are all babbitted up to a master shaft and scraped, so that all bearings come into perfect line.

The igniters are a simple and durable design and can be removed intact; there is a ground joint between cylinder and igniter castings. The electrode arms are clamped in position



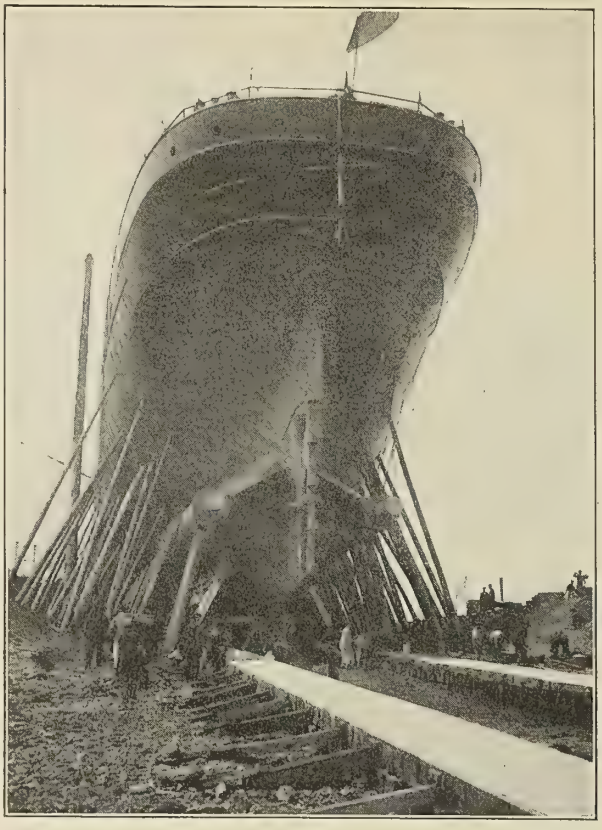
ENGINE OF THE STRANGER.

and allow for easily adjusting for wear and repairs. There is a special "Automatic" vaporizer and independent adjustment for the air and gasoline, which gives a range from 75 to 300 R. P. M., all controlled by one throttle valve.

The dredging outfit consists of one of the largest size "Automatic" fore-and-aft double-arm hoisters, and is equipped with "Automatic" dredges of 15 bushels capacity. There is an extra wide brake band for braking, extending nearly the whole diameter of drum and operated with rack and pinion, which gives a very simple and durable gear.

The Launch of the New French Liner La Provence.

On the 21st of March the latest flyer of the French Line was successfully launched near St. Nazaire, in the presence of the Ministers of Commerce and Public Works and the First Secretary of Marine. The *Provence* is of considerably larger size than the ships of the French Line at present in service, and, indeed, is the largest ship of the French mercantile marine, and the largest ship ever built in France.



LA PROVENCE ON THE WAYS.

She has a length of 625 feet with beam of 69 feet, and displaces at a draft of 26 feet 19,200 tons. She is fitted with two engines operating twin screws and developing a total of 30,000 indicated horsepower, with which it is expected that a speed of 23 knots will be maintained. The draft has been limited because of the fact that the harbor of Havre, which is the eastern terminus of the trip of the French liners, is relatively shallow, and will not admit of the draft given the English ships entering the port of

LA PROVENCE AFLOAT.

New York. The ship was commenced in December, 1903, and is expected to be ready for service early in 1906. It was proposed when the plans were being considered to fit her with turbine engines, but the Companie Generale Transatlantique had scarcely the courage to initiate this system in a steamer of such importance. Her crew numbers 439 all told, and she has provision for 1,900 passengers.

J. Peltier.

The Stern Post and Heel-Piece of Warships.

BY EDWIN CERIO, NAVAL ARCHITECT.

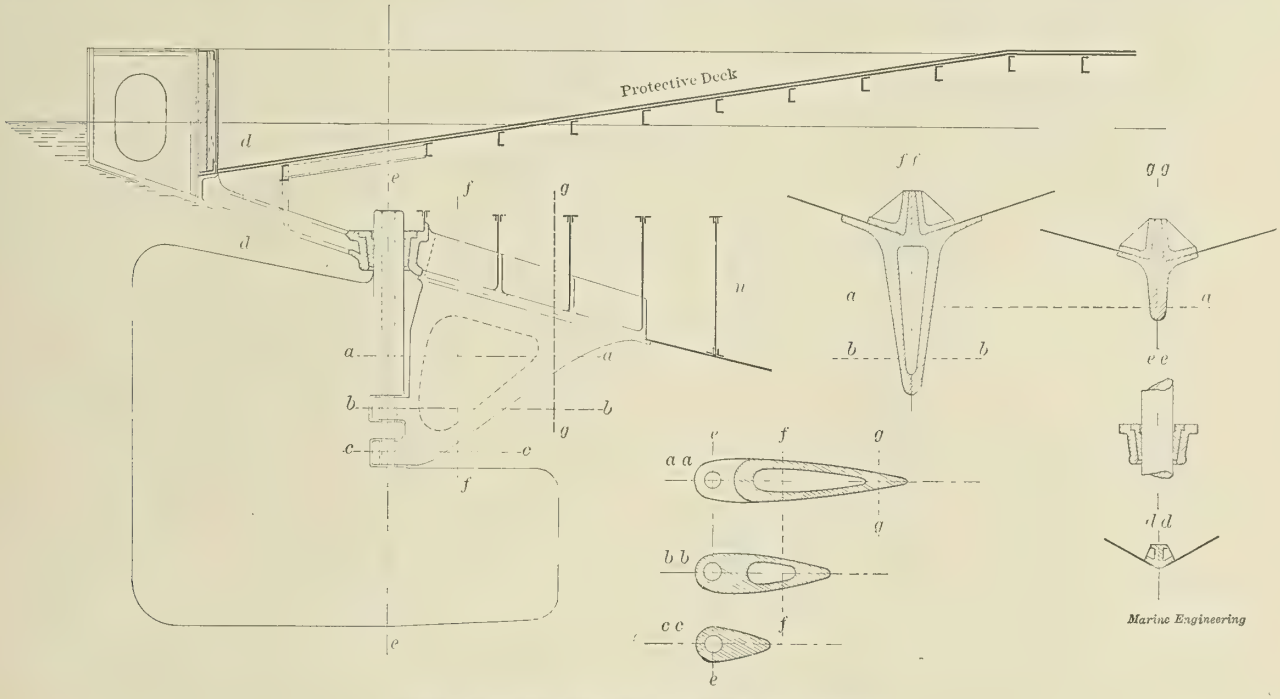
The accident which recently put an end to the trials of the German battleship *Elsass,* may be described as a fracture of the rudder bearing-piece *(heel-piece),* due to the vibrations of the stern at the high speed at which the vessel was running, and a consequent loss of the rudder. The accident alluded to, and its repetition under exactly the same circumstances in a number of ships fitted as the German man-of-war above mentioned, will not fail to call the attention of naval authorities to the structure usually adopted in warships having three screws and a balanced rudder. This structure consists of an extremely complicated stern post of cast steel, one part of which forms, so to speak, an arm protruding outside of the ship and serving to support the rudder. This arm is the *heel-piece,* and it carries the gudgeons for the rudder pintles. Heel-piece and stern post are cast in one piece, so that the latter is made to share the fate of its most fragile appendix, the fracture of which makes it indispensable to demolish the whole stern, tear away the outside plating, remove the stern post, frames, etc., and undertake a costly and lengthy reconstruction after the damaged stern post is replaced by a new one.

According to *Schiffbau,* the repairs necessary to put *Elsass* in order again will require a period of from one to three months; and though this estimate may have been made in a very optimistic frame of mind, it shows how serious the consequences of an accident to the heel-piece of a modern battleship may be. In time of peace the apprehension caused by this defective structure may be a cause of dissatisfaction in regard to a ship, but in time of war it may become an element of unreliability which it is most important to remove. Take for instance the case of a 16,000-ton battleship, completely armed and equipped, ready for action; a quite plausible assumption is that an external cause, such as grounding, the hit of a torpedo, etc., will produce the fatal fracture in the heel-piece, and the battleship which, *without* that insignificant fracture, would be capable of using all the destructive energy stowed in her sides, is condemned for months to idleness.

As the three-screw system and balanced rudders are becoming every day more popular, naval constructors must give a thought to the system of stern post adopted in ships thus fitted and answer the question: Is it possible to so modify the existing structure that an accident damaging the heel-piece will not disable the whole ship for a long period?

I have tried a practical solution of this problem which I here briefly describe and illustrate with the accompanying drawing. In my opinion much weight ought to be laid on the following points:

(1) Stern post and heel-piece must be independent from one another, and their structure ought to represent the best compromise between simplicity and solidity. Strength obtained at the cost of complicated castings, and lightness secured by reducing the thickness to the theorical *minimum* determined by calculation, are apt to prove uneconomical, and, what is worse, fatal to the ship's military value.



DESIGN FOR STERN POST AND HEEL-PIECE IN WARSHIPS.

(2) Stern post and heel-piece must, therefore, be made of two separate castings, solidly connected together by means of rivets and bolts.

(3) The operation by means of which the part eventually damaged (as a rule the heelpiece) is removed and a reserve piece, *kept ready on board,* is replaced, must be capable of being simply and quickly performed.

(4) The structure must be such that in case of accident the necessary repairs will concern only the damaged part, and not involve the demolition and reconstruction of the whole stern of the vessel below the water-line. Experience has taught that this reconstruction, owing to the locality where the work must be done (under the armor deck) is a fastidious and costly job.

As the fracture, when the heel-piece is struck, usually takes place along the line *a-a* (see figure), or may, by means of an adequate construction, be made to take place in this direction, the proposed system has been designed with a view to embodying the suggestions above mentioned.

The drawing shows clearly all particulars of the modification I suggest to the system now in use; the horizontal sections *a-a, b-b, c-c,* and the vertical sections *d-d, e-e, f-f, g-g,* furnish exhaustive details of this structure, which aims to combine constructive with economical advantages.

Mr. Grant B. Shipley has severed his connection with the Union Iron Works, of San Francisco, where he was chief draftsman of the mining department, and is now to be found with the Allis-Chalmers Company, in Chicago.

THE RECONSTRUCTION OF THE TURKISH FLEET.

BY DAGNINO ATTILIO.

The reconstruction of the Turkish fleet has for so many years been regarded as more or less of a myth that it is not generally known that anything definite has been accomplished. It is a fact, however, that although the complete reconstruction may never take place, a very substantial beginning has been made by the rebuilding, by Messrs. Ansaldo, shipbuilders of Genoa, of the largest ship in the Turkish navy, the *Mess'oudijeh*, and by the construction of four 26-knot torpedo-boats, and the further construction of seven of the same type, which are now rapidly nearing completion in their yard.

The *Mess'oudijeh*, which was designed by Sir Edwin J. Reed, late chief constructor of the British navy, and was launched on the Thames as long ago as 1874, has been transformed from a superannuated and, from a military point of view, almost valueless ironclad, into a very formidable ship. She has a displacement of 9,200 tons, measures 331 feet over all, 315 feet between perpendiculars, has a beam of 59 feet, with a maximum draft between 26 and 27 feet. The old armament was twelve 18-ton, 9-inch muzzle loaders, located in a central box battery; two 6-ton, 7-inch muzzle loaders, located forward; and a similar pair aft, and a few small guns. The battery was protected by 12 inches of wrought-iron armor, the armor belt varying in thickness from

THE MESS'OUDIJÉH BEFORE RECONSTRUCTION.

8 to 12 inches. With a total indicated horsepower of 7,430, the ship reached a speed on trial of about 13 knots. She was a full-rigged ship and was one of the latest single-screw warships built in England. At that time she was a formidable craft, comparing very favorably with ships of all the principal naval powers of that date.

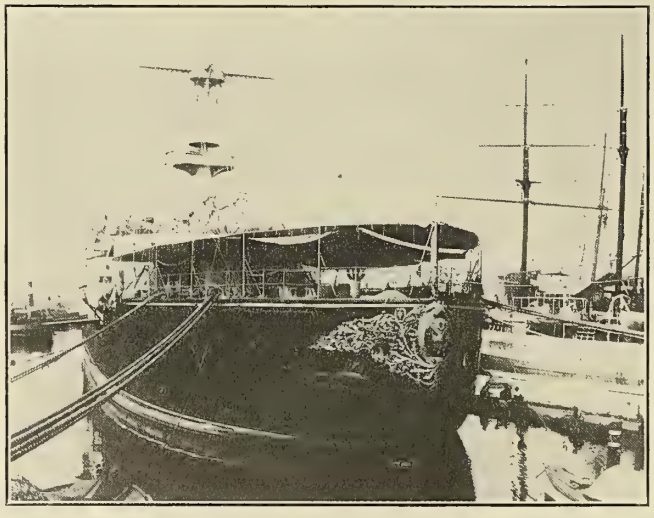
Twenty years after her launch her military value had so decreased, owing in part to the Turkish method of allowing ships to go to rust, and in part to the coincident progress in the design and construction of warships, as to have almost disappeared. About that time the Sultan Abdul Hamid II displayed a personal interest in naval matters, and negotiations were at once instituted with Messrs. Ansaldo looking to the reconstruction of this ship. Upon examination the hull was found to be in splendid condition, but otherwise she was practically hopeless. The engines were so badly rusted as to have fallen apart in many places, while the boilers bore a distinct resemblance to sieves. With considerable difficulty the ship was navigated to Genoa, and after many delays, due to the habitual procrastinating policy of the Turkish government, the rebuilding was taken in hand.

The first, and in many ways most difficult part of the task, was that necessitated at the stern, due to the fact that the substitution of twin screws for the old single screw was one of the features of the reconstruction. The ship was not lengthened, but a complete new stern was fitted to accommodate the new condition of affairs. Practically all of the old bulwarks fore and aft, including both the old poop and forecastle, were removed *in toto*, and amidships a light iron superstructure was built.

For the twelve old 18-ton guns in the central-box battery amidships have been substituted an equal number of 6-inch Vickers rapid-firing guns, 45 calibers long, and so situated that two can fire almost directly forward and two almost direct astern, while all, of course, have a considerable arc of fire on the broadside. These guns use the old gun ports, slightly enlarged, and are protected behind 4-inch shields. Forward and aft, on the main-deck, have been constructed barbettes, built on the "shallow tray" system, and carrying 6-inch turret shields over them. In each of these positions is located a Vickers 9.2-inch gun. The secondary battery consists of ten 3-inch, 14-pounder, rapid-firing guns, placed in the upper-deck superstructure, with two more of the same size forward under the main-deck, and two aft. On the flying-deck, over the superstructure, are ten 6-pounder guns, while the new military mast, placed aft of the two funnels, carries two 3-pounders.

An entire new set of engines has been built, being four-cylinder, triple-expansion engines, with cylinders as follows:

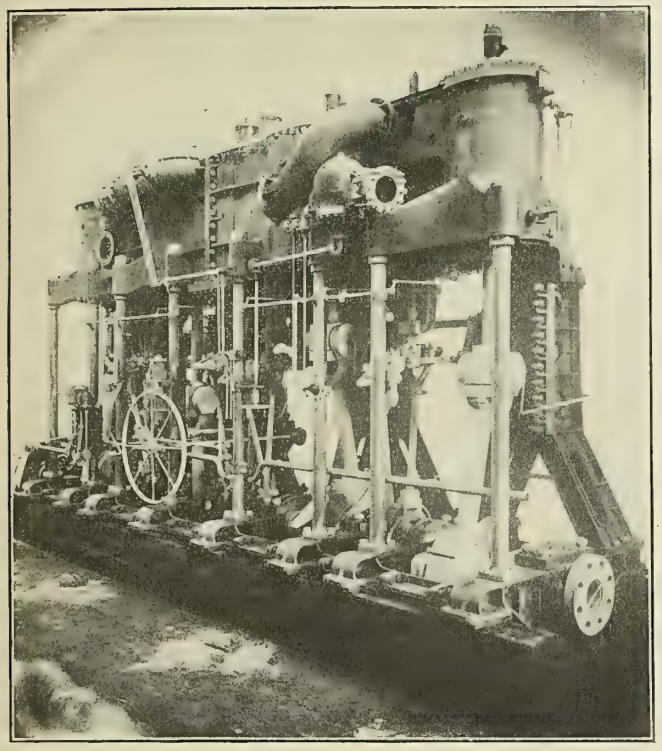
The propelling engines are right- and left-handed, and turn inwards. They are placed, as usual, side by side in separate



STERN OF THE RECONSTRUCTED IRONCLAD.

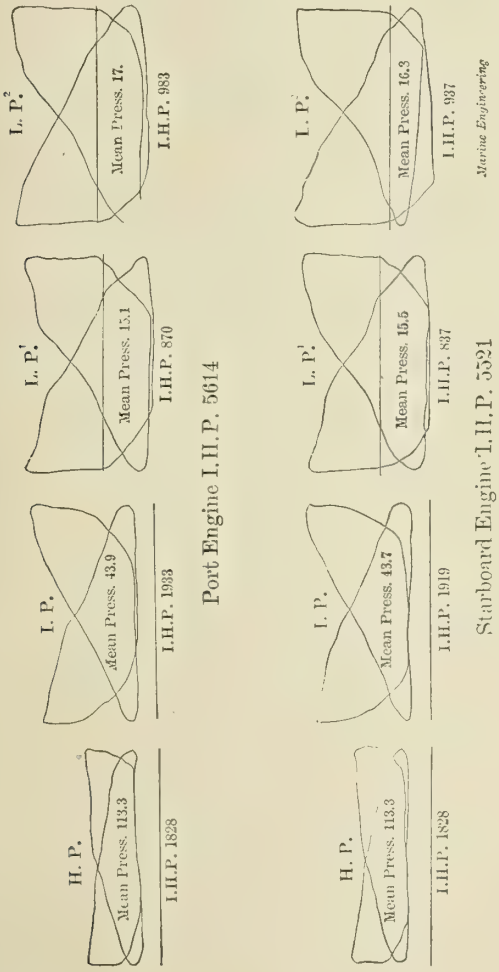
water-tight compartments, and are balanced on the Yarrow-Schlick-Tweedy system, the two low-pressures being between the high- and intermediate-pressures. The balancing has been proven to be most effective. The valves for the high- and intermediate-pressure cylinders are of the piston type, while the low-pressure cylinders use double-ported slide valves. The cylinders are independent castings, the two low-pressure cylinders forming a solid body with the low-pressure receivers, while the high- and intermediate-cylinders are secured to them by means of flanges and bolts. The engine framing consists of a cast-steel housing at the back and forged-steel columns at the front. The pistons are of cast steel, conical in shape, and all cylinders are fitted with working liners and are jacketed. The bed-plates are of cast steel.

There is a steam separator and a reducing valve for each engine, fitted on the forward engine-room bulkhead. The reversing gear is of the "all round" type, fitted with a double-cylinder engine. The two main condensers are separate and are placed in the wings. They are cylindrical, with shells of sheet brass and doors and tube plates of gun-metal. The total cooling surface is 11,030 square feet, which figures out at almost exactly one square foot per indicated horsepower of the engines. The water is supplied by two circulating pumps with runners 43 1-4 inches in diameter, each pump being operated by a double-cylinder engine measuring 8 1-4 by 8 1-4 inches. The exhaust



THE NEW ENGINES OF THE MESS'OUDIJEH.

steam from all auxiliary machinery on board is so connected that it may be led either into the funnel or into an auxiliary condenser in the port engine room. This latter condenser has its own air and circulating pump, entirely independent from the



MARINE ENGINEERING DATA CARD. | MAY, 1905.

NAME—Mess'Oudijeh. OWNER—Turke.

LAUNCHED—1874. NATIONALITY—Turkish. RECONSTRUCTED—By Messrs. Ansald

Length over all	331 ft.
" between perpendiculars	315 "
Beam molded	59 "
Maximum draught	27 "
Normal displacement	9,200 tons
Engines, twin screw, four-cylinder, triple	
Cylinder diam. 30, 49 1-4, 56 5-16, and 56 5-16 ins.	
Stroke	43 5-16 "
Piston rods, diam.	7 "
Connecting rods,	
mean diam. 7 11-16 ins., bored 4 ins.	
" rods, length,	
" center to center, 7 ft. 2 5-8 "	
Shafting, diam.	all 15 5-16 "
Main steam pipe, diam.	10 1-4 "
Stroke of H.P. valves	9 ins.
" " I.P. "	9 5-8 "
" " L.P. "	8 "
Air pump, diam.	26 ins. by 21 11-16
Cooling surface, two condensers	11,030 sq. ft.
" auxiliary condensers	1,302 " "
Propellers, 2, 4 manganese bronze blades	
Diameter, 17 ft. 8 1-2 in. Boss diam., 55 ins.	
Pitch mean	16 ft. 3 "
Projected area	88 sq. ft.
Developed area	102 " "
Pitch ratio	0.92
Boilers, type, Niclausse water tube	
Number	16
Elements, number	208
" length	8 ft. 6 7-16 ins.
Tubes, diameter, 3 1-4 outside, 2 15-16 inside	
" length	7 ft 10 1-2 ins.
Grate, length	7 ft.
" width	7 ft. 6 7-8 ins.
Total grate surface	846 sq. ft.
Total heating surface	26,992 " "
$\frac{H}{G} = 31.9$	
Working pressure	300 lbs.

main condensers, and has a cooling surface of 1,302 square feet. The casing of this condenser is of cast brass instead of the sheet brass in the main condensers.

The following steam pumps are fitted:

2 auxiliary air pumps for main condensers.	10	x	18		ins.
4 main feed pumps	9	x	7	x 9	"
4 auxiliary feed pumps	9	x	7	x 9	"
2 hot-well pumps	6	x	7¾	x 8	"
2 water-service pumps	5½	x	4¾	x 5	"
2 crank-pit pumps	5¼	x	4¾	x 5	"
4 bilge and fire pumps	9	x	6	x 9	"

Besides these pumps there are the oil pumps, etc. One large

THE MESS'OUDIJEH AS RECONSTRUCTED.

feed-water heater is placed on the forward engine-room bulkhead in the first fire room.

The propellers, which are two in number, have each four blades, and have a diameter of 17 feet 8 1-2 inches, and a mean pitch of 16 feet 3 inches, giving a pitch-ratio of 0.92. The bosses are of gun-metal and the blades of manganese bronze.

Steam is furnished by a battery of 16 Niclausse water-tube boilers, designed for a working pressure of 300 pounds, and arranged in two groups in four fire rooms. Each boiler has thirteen elements of 18 tubes, making a total of 208 elements and 3,744 tubes, the latter having an outside diameter of 3 1-4 inches and an inside diameter of 2 15-16 inches, this giving a thickness of 5-32 inch. The length of tubes is 7 feet 10 1-2 inches. The boilers are fitted with automatic feed valves, automatically closing fire doors, and balanced ash-pit doors. The total grate surface is 846 square feet, and the water-heating surface 26,992 square feet, giving a ratio of heating surface to grate area of 31.9 to 1. The boiler rooms are arranged for forced draft in closed stokeholds, but are not air-tight. The four blowers which provide the required air pressure are located over the protected deck.

On her official trial this old ship, which originally made only 13 knots, easily exceeded 17, with an indicated horsepower of 11,135, a performance which reflects great credit upon the builders who undertook the very serious task of reconstruction.

ELECTRIC STEERING.

BY GEORGE E. WALSH.

The saving of space in every possible way is the leading problem of every marine architect, and with modern highly complicated machinery for eliminating hand labor and clumsy operations the work of economizing space in the engine room requires special training. The chief advantage claimed in favor of liquid fuel or coal briquettes for marine use is the smaller space which they occupy in the fuel bunkers, and the same applies with equal force to electrical apparatus as an auxiliary power for operating cranes, winches, lights, bulkhead doors, and steering gear. Every modern ship is to-day provided with its electrical plant for some one or more of these auxiliary purposes, and the question of utilizing the current for additional machinery is receiving practical demonstration every day. Such new steamers as the *Baltic* indicate the extent to which electricity is utilized on modern products of the shipyard. Not only is the fuel handled by electric cranes and buckets, but all deck cranes and winches are electrically worked, and bulkhead doors, steering apparatus, signal lights, and fog horns are similarly operated. Cabins and state rooms are lighted and heated by electric power, and even the cooking in the kitchen is performed by this agency. Altogether, the use of electricity is so general that every part of the ship is wired, and standing on the bridge or in the pilot house the captain can keep in direct communication with every officer and engineer. Automatic signal lights keep him informed of the condition and progress of his ship. The log and lead automatically register on a small dial before him the speed of the ship and the depth of the water, while red and white lights in another row show him whether bulkhead doors are opened or closed. By touching a button he can close the bulkhead doors singly or in series, and they remain closed until released by him. The proper signal lights on the ship are also indicated by small colored lights in the pilot room so that any mistake or oversight of a subordinate is immediately made manifest to the navigator. There is, in fact, in the pilot house or on the bridge, such a complete arrangement of electric lights and buttons that the captain knows absolutely the condition of every important part of his ship, and he has such complete control over its varied and complicated mechanism that in an emergency he could act instantly and intelligently to save the ship.

All of this highly-developed mechanism has been the direct result of introducing electricity on shipboard. Without it there would be little chance of placing such absolute control of the ship in the hands of the navigator. The further extension of electric control in warships might be mentioned, for guns, turrets, torpedo tubes, and ammunition hoists are nearly all operated to-day by electric power. The economy in space through the use of electric current on warships amounts to nearly 20 percent of the whole space available for machinery and operating devices. A modern battleship would have to be increased greatly in size to make it equally efficient if electricity were entirely removed.

In the development of electric control of mechanism on shipboard that of steering has probably been slower than many others. Owing to many difficulties electric steering apparatus has gone through a long stage of evolutionary development, and it is not until comparatively recently that marine architects have adopted it generally. Electric steering devices were designed nearly twenty years ago, but they were not adopted by shipbuilders. There is still to a certain extent a difference of opinion in regard to the advantages of electric steering, and a considerable lack of uniformity of devices employed.

One of the first of the ocean steamers to receive a complete steering unit was the North Atlantic liner *Finland,* of the Red Star line. This steamship, of 13,000 tons, with a speed of 17 knots per hour, is equipped with an electric steering gear in which a 60-horse-power motor of 110 volts is mounted on a Brown tiller. This steamer was built by the William Cramp & Sons Ship and Engine Building Company, of Philadelphia, and the steering apparatus was the first ever extensively employed in this country on a ship of any considerable size. Before the *Finland* was equipped a number of ships had been fitted with auxiliary electric steering apparatus to take the place of hand steering gear, and also for emergencies when the steam gear should break down. As an auxiliary the electric steering gear proves of the greatest value, and it is only necessary to connect the motor driving the rudder to any one of the ship's dynamos. This enables the ship in an accident to proceed under full speed, and not slow down, as is necessary when resort to hand-gear steering is adopted.

The ordinary auxiliary, or spare electric steering gear, is generally composed of a motor generator of 2 Kw. capacity connected directly when needed to the ship's dynamo. There is an automatic following-up gear, and a steering column located on the bridge. Steering by this method in times of trouble with the ordinary steering apparatus has been quite universally adopted on the older ships where an auxiliary device was needed for emergencies.

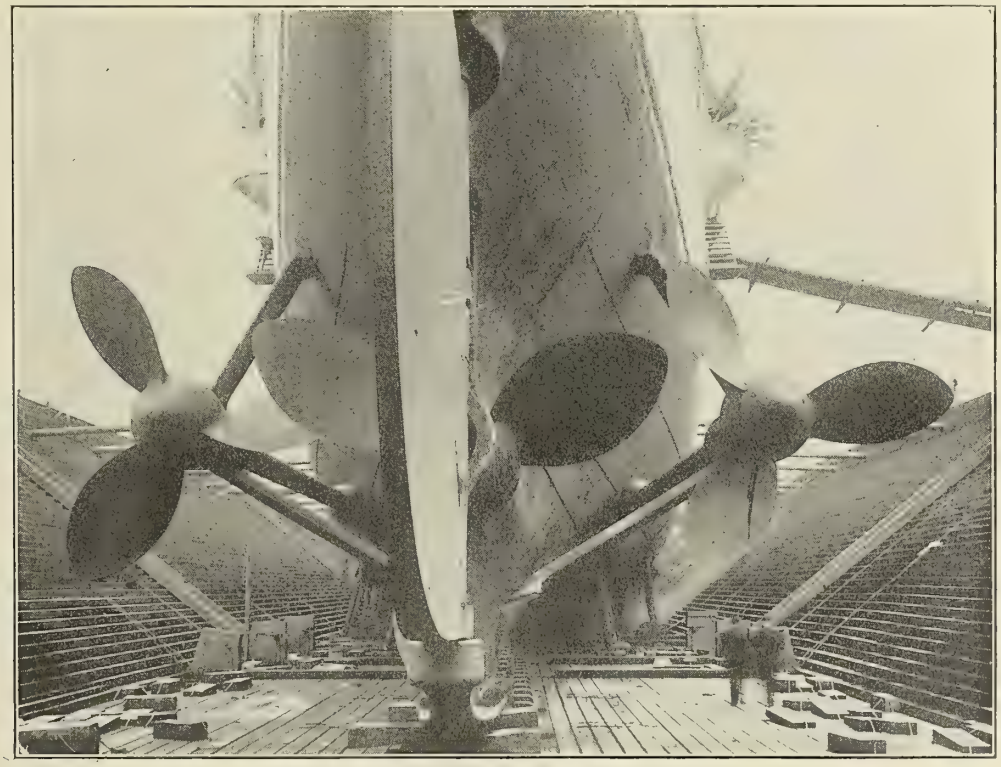
The perfected steering apparatus of the new ocean steamships, war vessels, and sea-going steam yachts consists of a motor geared to the rudder and connected by wire to a special electric generator or ordinary ship's dynamo used for miscellaneous purposes. The current, through two field windings wound in opposite directions, enters the steering wheel house, so that the mechanism can be controlled entirely by the man at the wheel. When the wheel is turned in one direction, a rheostat arm is shifted, and a larger current flows in one field winding and causes the rudder to move in the desired direction. In some of the large ocean-going steam yachts a quadrapolar motor of the enclosed type drives a left- and right-hand screw which connects to a crosspiece on the rudder post by links. By turning this screw the rudder is operated. If the electric current should fail, the steering could be done by hand. The steering wheel, when rotated through twelve revolutions, turns the rudder a distance of 80 degrees, and a switching device then automatically cuts off the current to prevent any further movement when the extreme positions are reached. The motor drives the screw through spur gearing and a claw clutch. The motor is direct current, series wound, and provided with a brake which is held off by an electro magnet. As the brake is held on by a stiff spring, the rudder is always at rest when the current is cut off. A small metal disc is geared to the screw, with two switch arms mounted on it to show the position and movement of the rudder. The motion of the arms on the disc is exactly the same as that of the

screw to which they are geared, and it is impossible to show anything except the actual position of the rudder at any time. Nothing except the complete derangement of the screw could make the disc reading incorrect.

A number of ship's steering devices to be operated by electricity have been invented and practically demonstrated. The Earl of Crawford's yacht *Valhalla,* 239 feet long and with a tonnage of 1,490, has a steering apparatus similar to the above. The Russian cruiser *Variag,* which met with such a sudden fate early in the present war, had an electric steering apparatus in which the motors were directly geared to the rudder. A number of the ships of the Baltic squadron, now on its way to the Far East, have also electrically-operated steering devices, while some of our newest ships for use on the Pacific coast are similarly equipped. The tendency is toward electric steering, because of the economy of space and simplicity of operation.

A good many ship builders and ship owners have been unwilling in the past to adopt electric steering exclusively because of a lack of practical demonstration of its efficacy. This deficiency is now being partially supplied, and electricity is being adopted more generally for steering as in all other departments. As an auxiliary for emergencies, the electric steering apparatus is the most popular and serviceable yet invented. It can be installed easily and cheaply on any ship that uses one or more dynamos for operating cranes, winches, electric lights or other machinery. The cost of operating such an auxiliary installation is nothing except during the time of working, and the wiring can be arranged so that no interference with the regular steam steering need be made. Electric steering is as reliable to-day as any other method, and much simpler and cheaper than steam. It is cheaper than steam, it is cheaper than any other power because there is no waste of energy when the motors are not in operation. There is a saving of space because the motors are attached or geared directly to the rudders, and there is little internal mechanism other than the regular dynamo used for general purposes on the ship. Where steam pipes are used the loss through condensation is quite a considerable item. As electric ventilators, search lights, and arc and incandescent lights are the most efficient yet installed on modern warships and ocean steamships, so electric steering devices are proving the most economical and desirable in nearly all cases where they have been practically tested.

As a final field in which electric steering apparatus has been utilized with success, mention should be made of the torpedo craft. These little engines of war are compressed into as small a space as possible, and any power that will steer or drive them through the water with automatic regularity and certainty is bound to receive attention. Automatically-steered electric torpedoes and torpedo boats have been tested time and again. So well has electricity been adapted in this field that a craft can be started from a given point and be made to travel around a distant point and back again without carrying a human soul. The electric steering apparatus performs the whole work, operating automatically by a simple mechanism. Torpedo boats thus equipped can be controlled from a given station by wires and made to manœuvre around a hostile fleet. As a step in advance of this, we have the torpedoes controlled by wireless electricity. According to the devices thus employed, the torpedoes can be launched from some unseen land station and directed through the water by a most circuitous route to attack a vessel in the open seas. Thus electricity in one form or another promises to improve the operation of our warships and implements of war, and to make the control of ordinary merchant ships more satisfactory than ever, as they sail the high seas on their missions of peace.



THE STERN OF THE TRIPLE-SCREW CRUISER COLUMBIA.
(Photo by W. H. Rau.)

The Columbia in Dry-Dock.

We present herewith a picture of the stern of the United States protected cruiser *Columbia* in dry-dock, showing the arrangement and size of the three propellers by which the ship is driven. The *Columbia* has a displacement of 7,350 tons, a length of 412 feet on the water-line, a beam of 58 feet 2 1-2 inches, and a mean draft at normal displacement of 22 feet 6 1-2 inches. On trial she developed 18,509 horsepower and a mean speed for four hours of 22.8 knots, this giving her at that time the record in cruiser speed, not only for our navy, but for all the navies of the world as well. She was the first ship of any importance to be fitted with triple screws.

SHIPBUILDING IN SCOTLAND IN 1904.

BY BENJAMIN TAYLOR.

This has not by any means been a record year in the Scotch shipyards, but the total of tonnage launched has turned out greater than was at one time anticipated. The total of the Clyde has been 234 steamers of 382,716 tons, and 80 sailing vessels of 33,089 tons, in all, 314 vessels of 415,725 tons as compared with 277 vessels of 446,869 tons in 1903. This is a shortfall of 31,144 tons on the year, but that is nothing compared with Belfast, where the output has been only 76,114 tons, as compared with 155,200 tons in 1903. This decrease at Belfast is due to the slackness at Harland and Wolff's yard, where no more monster liners have been built, either for the Morgan combine or for the German companies. On the Clyde, the largest producers have been Russell & Company, Port Glasgow, with 13 steamers of 73,689 tons; the next Charles Connell & Company, with 10 steamers of 40,895 tons; and the third, Barclay, Curle & Company, with 10 steamers of 36,408 tons. Russell & Company's output is the largest in the world this year, not excepting the American Shipbuilding Company with its five yards. The next largest producers to Russell & Company in Great Britain are Swan-Hunter and Wigham-Richardson, Tyne, with 59,099 tons, and William Gray & Company, Hartlepool, with 57,357 tons. Nearly all the Scotch shipbuilding is on the Clyde, which has some 50 building yards of all sizes, capable of turning out expeditiously every description of floating craft from barges to battleships. There are also a few busy yards at Leith, Dundee, and Aberdeen. Taking the 1904 output in the United Kingdom at 1,401,200 tons, it will be seen that the Clyde is responsible for nearly one-third of it. The work, however, has been pretty unevenly divided in 1904, and some of the builders have fared badly while others have done well. A good deal of work remains on hand, but the prospects for 1905 are uncertain.

Just at the close of 1904 one of the most interesting products of the year was launched from the yard of Alexander Stephen & Sons (Limited), namely, the new turbine steamer *Virginian,* of 11,200 tons, for the Allan Line. The *Virginian* is sister ship to the *Victorian,* launched by Workman, Clark & Company, Belfast, in August, and at present fitting out for sea, and they will be the first turbine liners to engage in the cross-Atlantic service. Both vessels will be placed on the Canadian mail and passenger service from Liverpool, the *Victorian* sailing on her maiden voyage to Halifax, Nova Scotia, and St. Johns, N. B., on March 23, and the *Virginian* for the same ports on April 6. These vessels mark a notable advance in the progress of the steam turbine as applied to ocean steamers. The *Virginian's* dimensions are 540 feet length over all, 60 feet beam, and 41 feet depth. She has been constructed under the supervision of the Allan Company's representatives, to the highest class in the British Corporation, and to the passenger requirements of both the British Board of Trade and the American laws. She has accommodation for 1,650 passengers, 470 first-class, 240 second-class, and 940 third-class. The vessel has a poop, long bridge, and forecastle, with large houses in the wells between the hatches, the tops of the poop and houses being arranged as promenades for passengers, and sheltered by boat decks, which again form promenades sheltered by awnings. On the bridge deck is a long deck house containing first-class state rooms, with a wide alleyway on each side; above is the promenade deck with deck houses containing the first-class music and other saloons, sheltered by the boat deck, which is itself a wide promenade having the officers' quarters and navigating bridge at the fore end, and on each side a range of boats the full length of the deck. The steamer is specially designed for the conveyance of the Canadian mails and passengers, five decks being fitted up for their accommodation, but she has also considerable cargo space in the holds fore and aft. The first-class dining saloon, at the fore end of the bridge, has accommodations for 200 persons. The decorations are Georgian style, the paneling of mahogany, toned to a deep color relieved by inlays. A large and airy nursery has been provided for younger passengers. The second saloon, on the main deck, is arranged to seat over 200 passengers, and is pleasingly decorated. In the 'tween decks forward and aft of the cabin passengers are state rooms for the third-class passengers. The deck below is also fitted up with state rooms for the same class, but with portable divisions, so that when not required these rooms can be removed. The cabin accommodation is heated throughout by steam, so arranged that each individual passenger can modify the heat to suit himself. Electric light is fitted throughout, and there is also an installation of the Marconi telegraph. The turbines, which are being supplied by the Parsons Marine Steam Turbine Company (Limited), are to drive the vessel at a high rate of speed. Steam of high pressure will be supplied to the turbines by nine single-ended boilers fitted with forced draft. The boilers and auxiliary machinery have been supplied from the engine works of the builders, Alexander Stephen & Sons (Limited). The turbine machinery is not yet in a condition to describe, but will be rapidly completed. Mr. Nathaniel Dunlop, senior partner of the Allan Company, says that in adopting the turbine method of propulsion they were aware that for ocean navigation it would require important and special adaptations, owing to the enormous power to be developed, and the need of great stopping and reversing power for manœuvring purposes. Mr. Parsons examined the problem and satisfied both himself and them that it could be solved. They had no hesitation in accepting his assurance, and nothing has occurred in the process of construction to disturb their confidence in the system. He made this statement because a paragraph appeared some time ago in the American press to the effect that the turbines had not answered the expectations of the Allan Line, and had not come up to the contract power. That statement was actually issued before the turbines were made, and before any trials of their power were possible. The turbine promised many advantages to travelers by sea, its noiseless and uniform motion imparting a corresponding measure of steadiness to the ship in heavy weather. The speed, too, of these turbines on the Atlantic would reduce the time at sea, and, together with the shorter mileage of the Canadian route, and its land-sheltered navigation on the Canadian side, should make it a favorite line of travel to and from the American continent.

Also at the close of the year, another turbine steamer was launched, viz., by the Fairfield Shipbuilding and Engineering Company (Limited), the twin-screw turbine yacht *Narcissus,* for Mr. A. E. Miller-Mundy, of Shipley Hall, Derby. This vessel is 245 feet long over all, 27 feet 6 inches wide, and 16 feet 3 inches deep to the main deck, and has a Thames measurement tonnage of 782 tons. She has been specially designed by the Fairfield Company, and constructed by them in a most substantial manner, in conformity with the requirements of Lloyd's highest yacht class. Great attention has been paid to form, as well as to the lines of sheer, the contours of stern and cutwater, and also to the placing of masts and funnel, so as to secure the utmost of symmetry and grace. She has been designed with a continuous main or weather deck with cabin deck below forward and aft, a long deck house covered by a shade deck amidships, and rail-high forecastle forward. On the shade deck are the captain's room and chart room, with navigation bridge above. In the forward part of the deck house, on the main deck, is a handsome drawing room lit by large square plate-glass windows. This apartment measures about 14 feet square and will be warmed by an open coal fire. Aft of the drawing room is the main entrance leading to dining saloon and owner's private apartments on the cabin deck, as well as to the drawing room and smoking room. The central deck house is broken by a convenient cross passage from which a ladderway ascends to the shade deck. This passage renders communication easy from side to side without having to go around the deck house, as is the case in so many large steam yachts. The engine hatch measures only 14 feet by 8 feet, as no part of the machinery extends above the main deck. In this casing is the main starting and manœuvring platform. Abaft the engine casing is a large deck house containing the after entrance leading to cabins on the

deck below. The after portion of the main deck, clear of the shelter afforded by the shade deck, is occupied by promenade space. On the cabin deck the forward part is taken up by a spacious forecastle, fitted up for 18 seamen and firemen. Immediately aft of the crew space are the officers' quarters and mess room and the owner's private cabin with valet's room. Aft of this is the dining saloon, extending the full width of the vessel and occupying 17 feet of her length, and to accommodate 12 persons. A range of six large state rooms with two roomy bathrooms, is situated aft of the boiler, bunker, and engine spaces, while at the after end of this suite are a maids' room and linen rooms. There are coal bunkers to contain 120 tons of coal amidships, the after hold being occupied by the screw shafts and electric accumulators. The whole of the living quarters are heated by a hot-water heating system having a slow combustion furnace placed in a recess off the main stokehold. This system is in addition to the open fires. Throughout the vessel electric lighting is fitted. The *Narcissus* carries two steam launches, one of 27 feet and one of 16 feet in length, together with two cutters, one gig, and one small dingy. The vessel, which marks another step in the application of turbine propulsion to vessels of the yachting fleet, is schooner rigged with two pole masts. She will be driven by twin screws, and the propelling machinery consists of two independent Parsons compound steam turbines, and one condenser. There is one high-pressure turbine on the port side and one low-pressure turbine on the starboard side of the ship, and a reversing turbine is incorporated with each. These two turbines will each drive a separate shaft, with one propeller on each shaft, and the engine room is fitted with appliances for ensuring economy of working. The boilers for generating the steam are two in number, of the cylindrical multi-tubular marine type, constructed entirely of steel, and adapted for a working pressure of 180 pounds per square inch.

Another notable launch of the Christmas season of 1904 was a new P. and O. liner. Barclay, Curle & Company (Limited) launched the twin-screw steamer *Poona,* built for the Eastern and Australian service of the Peninsular and Oriental Steam Navigation Company. The keel of the *Poona* was laid on June 14, 1904, and within eight months from the time the contract was placed she will be delivered complete to her owners. The *Poona* is 496 feet long by 57 feet 3 inches in breadth, by 35 feet 9 inches molded depth, and her deadweight carrying capacity is 10,000 tons. She is classed to the British Corporation highest standard. There is accommodation for first-class passengers in commodious state rooms under the bridge. The officers' quarters are also under the bridge, and the crew are berthed in the poop and forecastle. The arrangements for working cargo include ten large steam cranes, four winches, and five derricks (one for lifts up to 30 tons), to ensure the rapid discharge of very large cargoes. Nos. 2 and 3 holds and lower 'tween decks are insulated for the carriage of frozen produce. The refrigerating machinery is placed in a large deck house on the upper deck in the forward well on the cold-air system, to enable chambers to be kept at a low, uniform temperature. The vessel is lighted throughout with electricity, and the 'tween decks are lighted and ventilated to comply with the Admiralty requirements for carrying troops. Steam steering gear is controlled from the bridge by a telemoter, and is placed directly over the rudder head. The machinery consists of two sets of powerful triple-expansion engines, constructed by the builders, and these are supplied with steam from two double-ended and two single-ended boilers, with a working pressure of 185 pounds. The chairman of the shipbuilding company said that the *Poona* was a duplicate of the *Palermo,* built by them last year, and they had also on the stocks another vessel similar to the *Poona.* Judging from the information they had received about the performances of the *Palermo,* he had not the slightest doubt that the *Poona* would be able to give a good account of herself. Mr. Taylor, for the P. and O. Company, said that at the present moment the company had under construction at various yards vessels aggregating 66,000 gross tons, placed this year to replace older vessels, and were preparing themselves for any contingency likely to arise. Three of the vessels had been placed with Barclay, Curle & Company, which firm has been in existence since 1818, and this year they had turned out the largest tonnage in their history. For a number of years the P. and O. Company were conservative as regards the disposal of their new work, and most of the vessels were built by Caird & Company in Greenock, but one firm could not possibly undertake all their present requirements.

An interesting vessel, and one perhaps of a novel type for Americans, has just completed her trials on the Firth of Clyde, viz., the Indian government troopship *Dufferin,* the largest ship in the world of this class, which was built by Vickers, Sons & Maxim (Limited). The contract with the Indian Government called for a speed of 18.5 knots, and on six runs over the measured mile at Skelmorlie, on the Clyde, the actual rate attained was 18.9 knots. These six runs followed upon a series of trials at progressive speeds, for the information of the builders, and gave uniform results. Four of the runs were made in 3 minutes 10 seconds, or 3 minutes 11 seconds, and the mean of mean speed was 18.9 knots, nearly half a mile over the contract. This was realized with the engines making an average of 117.8 revolutions and indicating 9,975 horse power. The ship, on a six hours' contract run, gave the following mean results: Steam pressure at the boilers, 179 pounds; at the engines, 178 pounds; revolutions of starboard engine, 115.2; of port engine, 116.3; power indicated by starboard engine, 4,992; by port engine, 4,889; collective power, 9,881 I.H.P. Circulating, steering, and other manœuvring trials were carried out on the way to Barrow. The *Dufferin* was designed by Sir Edward J. Reed, K.C.B., the consulting naval architect for the Indian Government. She has a length between perpendiculars of 437 feet, a beam of 52 feet 6 inches, and displaces 7,340 tons at 19 feet draft, and accommodation is provided for 1,200 officers, troops, etc. The advance in propulsive efficiency is marked by the circumstance that, although the *Dufferin* is 30 feet longer, and correspondingly greater in displacement, than her immediate predecessor, the *Harding,* the same speed has been realized without material increase in engine power. The *Dufferin* differs little in construction and internal arrangements from the first-class modern merchant ship, but is designed with due consideration to adoption as an armored cruiser, and thus will be provided with eight 4.7-inch q. f. guns and eight 3-pounder q. f., the largest size of searchlight projector, large magazines and armory under the water-line, and other similar auxiliaries. There is a cellular double bottom, within which may be carried 800 tons of fresh water, and there are distillers for making 35 tons per day. She is built of strong scantling with four complete decks and a boat or promenade deck amidships extending about half the length of the vessel. There are a large number of water-tight compartments, and for the first time in a troopship has been introduced the Stone-Lloyd system of control for water-tight bulkhead doors. By this system all the doors can be closed by hydraulic gear from the captain's bridge, though any one door may be closed from several positions, while automatic arrangements are provided so that the flow of water into any one compartment would at once close the door of communication from such compartment to others. At the same time, a bell is rung at the door to give sufficient warning to any one in the compartment at the time of the impending closure. Teak has been used throughout for decks, etc., and ventilation has had primary consideration. The vessel has twin-screw, triple-expansion engines, the cylinders being 30 inches, 47 inches, and 75 inches in diameter by 48 inches stroke, and in their design large surfaces have been provided to ensure the maximum of efficiency with the least possible likelihood of trouble. There are four double-ended boilers.

Mr. Erwin S. Cooley has just been commissioned a second assistant engineer in the United States revenue cutter service, and is at present attached to the U. S. S. *Dexter,* stationed at San Juan, Porto Rico.

THE NEW THAMES PASSENGER STEAMERS.*

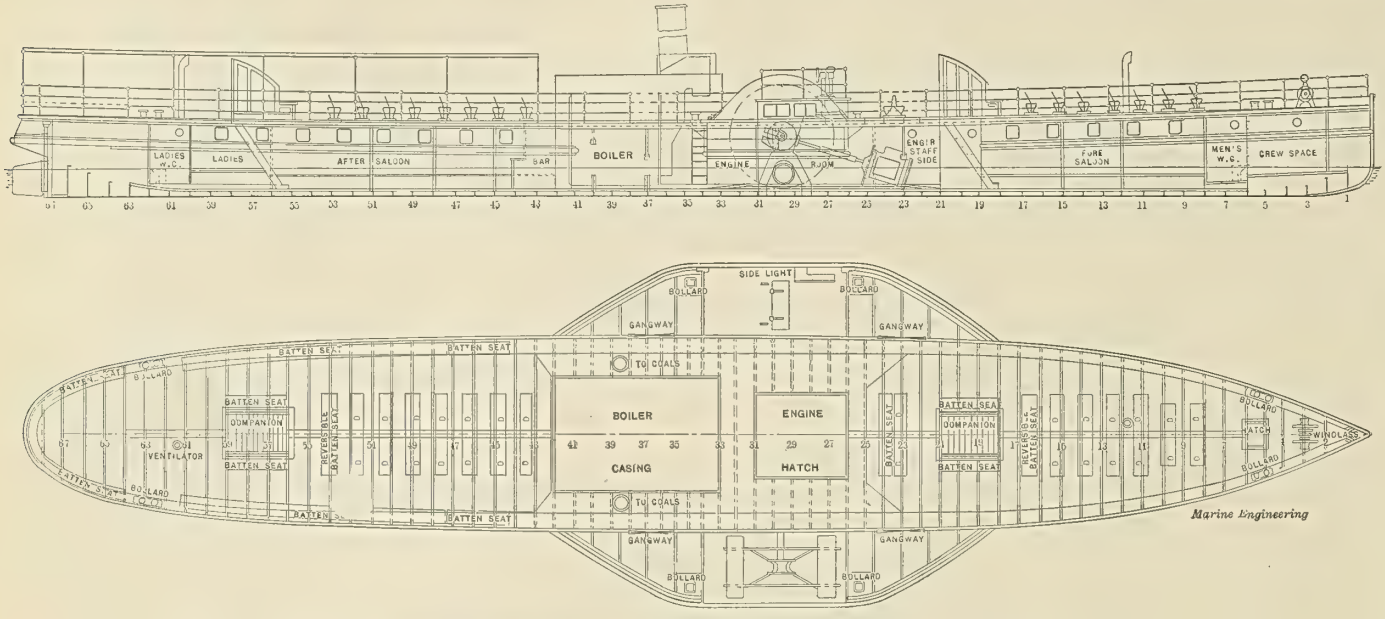
Since the discontinuance of operations by the Thames Steamboat Company, the question of a passenger steamboat service on the river has been frequently mooted and as often discussed but in a somewhat perfunctory manner by the London county council, without any unanimous decision as to the necessity for such a service, until within the last six months, during which time it has been decided that such a service shall be established, the boats employed in it to run between Hammersmith and Greenwich.

Consequent on this decision it was agreed by the council to invite a tender for the construction of the proposed fleet of steamers, which was to be 30 in number, the proposed design of the boats to accompany the tender for their construction.

So far as the type of boat for the intended service was concerned, the London county council, after the fullest consideration of all the conditions under which that service was to be carried on, concluded that the best kind of boat would be that propelled by paddlewheels; the Thames river service being peculiar, in that

40 tons weight on board, representing passengers, coal, crew, etc. The speed with this load on a three hours' trial to be 13 miles an hour, or a 12 mile working speed when on service. The engines to insure this speed—under onerous penalties—to be of the compound surface-condensing type, their power being left to their builders to determine.

To meet these conditions the following dimensions and particulars were adopted: length, 130 feet; beam, 16 feet 6 inches; and loaded draft 2 feet 10 inches, the intended working speed at that draft being 12 statute miles per hour. The motive power to attain that speed in regular service is to be obtained in each boat by an engine of the diagonal two-cylinder compound type situated forward of the shaft and driving a pair of paddlewheels 10 feet 6 inches in diameter over the floats. The engine cylinders are 16 and 31 inches in diameter with a common stroke of 30 inches, the working pressure being 115 pounds per square inch. When running at a speed of 55 revolutions per minute it is expected that 270 indicated horsepower will be developed.



INBOARD PROFILE AND PLAN OF NEW THAMES PASSENGER STEAMERS.

its tide, which rises and falls twice daily as much as 18 feet, limits the height above water of any part of the boat's structure or fittings, such as stanchions, awnings, etc., to 12 feet 6 inches; the numerous bridges that have to be passed on the Hammersmith service would be fouled at high water, and as the tide recedes so much at low water, the boats would be in danger of getting aground if drawing more than 2 feet 10 inches to 3 feet. As far as their speed is concerned, the frequent stoppages caused by the crowded state of the river precludes a high engine power being employed, and the limited draft of water, together with the stringency of the Thames conservancy laws as to "steamers' wash," had to be considered in deciding on the design and dimensions of the vessels.

Taking the foregoing considerations into account, the London county council on the 27th of last July invited the Thames Iron Works Company to tender for the construction and fittings of 30 steamers, or any lesser number as low as 10, as they could not accept a variety of designs. This company could lay down and build in its shipyard as many as 20 hulls of such vessels, and construct all the engines for the whole fleet at the Greenwich engine works; so prepared a design to fulfil the requirements of the council, which were as follows: Length not to exceed 140 feet, but less preferred; breadth to be left to the builders; depth molded, 7 feet; draft of water not to exceed 2 feet 10 inches, with

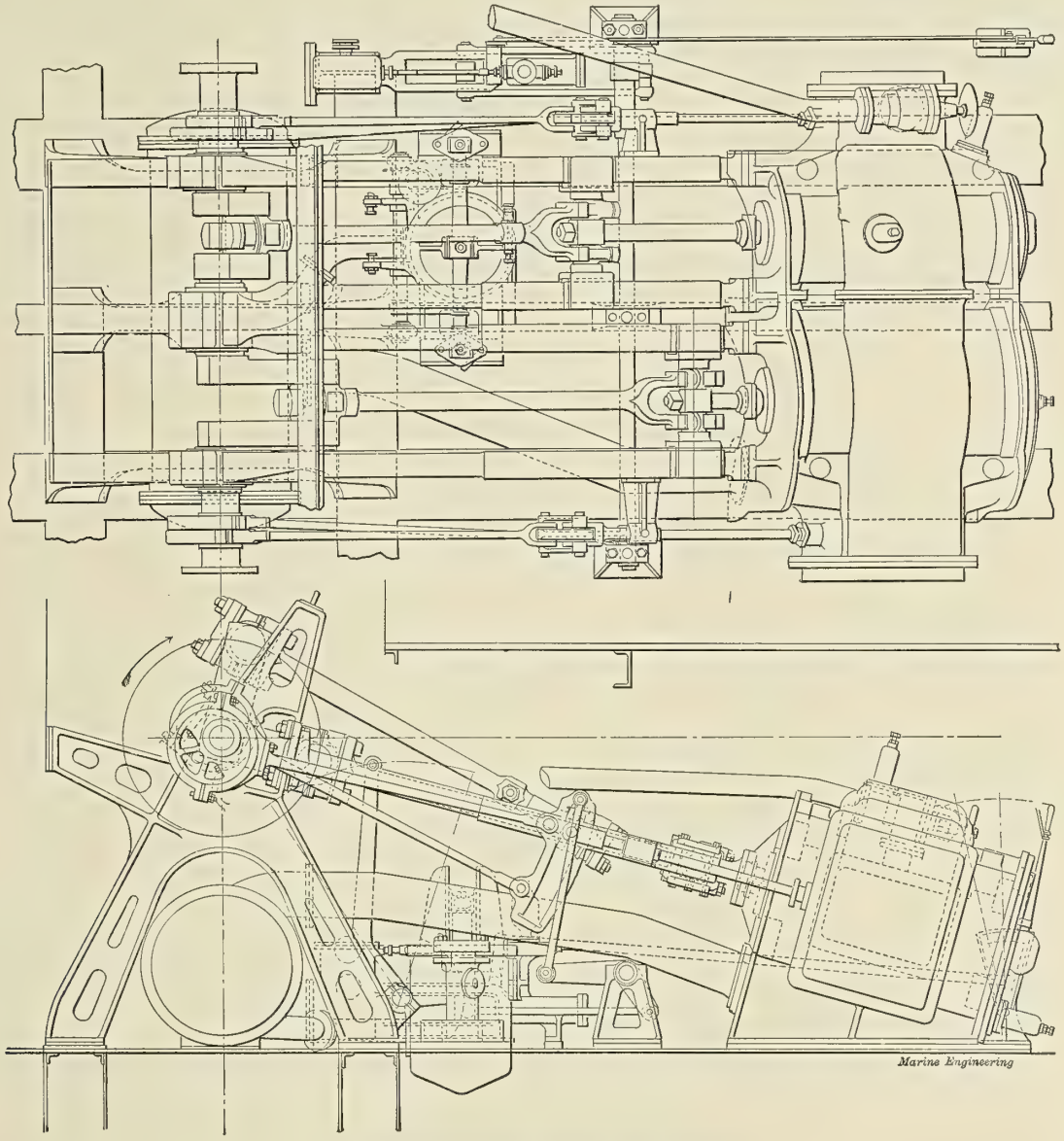
The engine, it will be seen, consists of three A-shaped cast-iron frames carrying the main crank-shaft bearings, the frames being securely bolted at their feet to seatings worked up from the vessel's frames, and at their heads to the sponson beams as usual. The cylinders are placed as shown, in an inclined position forward of the paddle shaft, the high pressure being on the port side of the vessel; the piston-rod guide bars, which are of forged steel, on both cylinders forming the connections between them and the main bearing frames. The main crank shaft is of wrought steel 6 3-4 inches diameter, forged in one piece, having a coupling flange at each end, as shown, for connecting up to the paddlewheel shafts, which are also of steel.

The surface condenser, which is cylindrical in form and of light construction, is placed athwartships as shown, between the legs of the main bearing frames, its shell being built of Muntz metal plates riveted together and joints sweated, and its water ends of copper; the tubes, which are of brass, will be fitted into the tube plates with screwed glands and tape packing. The cooling water is supplied by an independent centrifugal circulating pump, a small auxiliary air pump being driven off the same engine. The main air pump, which is of the Edwards type, and which will be seen in the plan and side elevation, is placed aft of but on the center line of the high-pressure cylinder, is driven by link and lever gear off the high-pressure connecting rod, the feed and bilge pumps being also actuated by the same gear. The paddlewheels, which are of the feathering type, have arms and rims of wrought

Engineer, London.

iron, the wheel bosses being of cast steel, secured to the paddle shafts by steel pins. The floats are of American elm, the working pins of steel cased with gun metal, and the arm bosses and radius rods bushed with lignum vitæ.

Steam is supplied by an ordinary marine cylindrical boiler of the return-tube type, 9 feet diameter by 8 feet 9 inches long, having 700 square feet of heating surface and 25 square feet of fire-grate area; Howden's system of forced draft being applied, with a special spark arrester uptake. An independent fan and engine



THE INCLINED COMPOUND PADDLEWHEEL ENGINES.

are placed in the stokehold for the supply of air to the furnaces through the Howden apparatus, which delivers it to the fires considerably raised in temperature. For the ready handling of the main engine a Brown's steam starting engine is fitted—seen in illustration on the port side of the plan—having a by-pass valve to the low-pressure cylinder receiver. A silent blow-off to the condenser is also fitted to carry off any steam that may have accumulated during brief stoppages at the river piers. The engine-room equipment also includes a steam steering engine, an electric-light engine and dynamo, an auxiliary feed engine, and a large reserve feed-water tank.

We give a profile and plan of the vessels, as approved by the London county council for the proposed Thames passenger service, showing the arrangement of seating on deck, and the extent of saloon space below, for the accommodation of passengers. The construction of the fleet of 30 boats has been divided between three firms, viz., The Thames Iron Works Company, of Blackwall; Messrs. J. I. Thornycroft & Company, of Chiswick; and Messrs. Napier, Miller & Company, on the Clyde; each of which will build 10 hulls, the first-named firm contracting to build both the hulls and engines, and the last mentioned 20 sets of machinery in addition to the 10 hulls.

So far as the boats to be built on the Thames at Blackwall are concerned, the work is already being rapidly pushed. The steel material for both hulls and engines is coming to hand. The deck planking is cut and seasoning, but it is not thought possible, under present weather conditions especially, that the fleet can be got ready for its intended service by May 1, as intended.

At an auction sale on the 14th of March, the shipbuilding plant on Shooter's Island, New York harbor, formerly owned and operated by Messrs. Townsend & Downey, was sold to the Colonial Trust Company for a total of $516,000. The plant is valued, at present, at about $2,000,000, while the liabilities under the assignment amounted to $870,000. It has not yet been announced whether or not the purchasers intend to operate the plant, but it is probable that some scheme for operation will be evolved at an early date.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

The edition of the May issue of Marine Engineering comprises 5,500 *copies. We have no free list, accept no return copies and issue only enough to supply the regular demand, so that the* 5,500 *copies represent legitimate circulation.*

The American merchant marine is still, like Mr. Micawber, "waiting for something to turn up."

The Transatlantic Yacht Race.

Within a few days the eleven yachts destined to take part in the sailing race across the Atlantic, for the cup offered by the Emperor of Germany, will begin to assemble and get into shape for the event. Of these yachts, it is interesting to note that six were built in the United States and the remaining five in Great Britain; while eight of the total number sail under the American flag, two under the English, and a single one under the German flag. The variation in size is quite considerable, ranging from 86 feet in length in the case of the American *Endymion,* to 240 feet for the English *Valhalla;* while in net tonnage the range is from 86 tons in the case of the American *Fleur-de-Lys,* to 648 for the big Englishman above mentioned. Nearly all the yachts are of very recent construction, there being only one which was built prior to 1890; that one is the famous *Sunbeam,* owned by Lord Brassey, and launched more than thirty years ago.

The problem of picking the winner is one which has engaged the attention of a great many yachting experts, and there is by no means any similarity of result. If the weather should prove to be very heavy, it seems to be supposed that the largest ships would have the best chance. This would appear to favor the *Valhalla,* which is more than 70 feet longer than her nearest competitor, and of more than double the tonnage. On the other hand, this ship is square rigged, and, therefore, would be unable to sail so good a race in case a large proportion of the weather showed head winds. If the latter sort of weather be encountered, some experts seem to think that the *Atlantic* will probably make as good a showing as any. The *Atlantic* is a three-masted schooner measuring 135 feet in length, and is of 206 net tons. Very light winds would probably favor the lighter of the vessels indicated, but it is anticipated that the race will not at all resemble the sort of drifting match which has been too frequently the spectacle in connection with the races for the *America's* cup. The record time in crossing the Atlantic under sail, under such conditions as this race will show, is somewhere near twelve days. It may be expected, therefore, that one or more of the ships will cross in under fifteen days, while it is not at all unlikely that the last one, barring accidents, will be able to make the passage in less than three weeks. A great deal of interest is centered in the race, much more so, in fact, than would probably be the case with the ordinary "marine circus," as one of our correspondents has designated the international races off Sandy Hook.

The Naval Conflict in the Far East.

It is with considerable trepidation that we attempt to discuss the situation in the China Sea as between the Russian and the Japanese fleets, which at the present writing seem to be practically within striking distance of each other. The situation will be developed so very rapidly when once the squadrons are within actual touch of each other that what we are writing to-day may become ancient history to-morrow, or perhaps be totally discounted by a sequence of events which do not at all bear out what appear to be the present probabilities of the case. As it looks at present, however, the two squadrons have a strength almost equal to each other, so far as pure *materiél* is concerned; for the Russians have four modern battleships of a very powerful type to oppose to the four which appear to be left from the six with which the Japanese started the war, and they have, moreover, one first-class and two second-class battleships, together with several armored cruising vessels of an obsolete pattern, to oppose to the Japanese vessels of the second rank, which consist with one exception of high-speed armored cruisers of excellent design and considerable power. So far as tonnage of

armored vessels goes, the Japanese are ahead, having a total of twelve ships amounting to 128,000 tons; while the Russians have apparently only ten ships amounting to about 110,000 tons; but the fact that a large proportion of the Russian ships are of the heavy fighting variety, designed to give and receive the heaviest blows, while so large a proportion of the Japanese are of the armored cruiser type, excellent in themselves, but unable to withstand successfully a heavy attack from the powerful ordnance carried by the five leading ships of the Russian fleet, renders the situation considerably more doubtful than would be the case were it possible to base an estimate on tonnage alone.

One point which has received a great deal of attention from the press is the question of speed as between the two fleets. It is reported that the Russian ships are badly covered with barnacles and other marine growths, and that their speed has consequently been reduced to such an extent that they will scarcely be able to do more than eight or ten knots; whereas the Japanese ships, although they have been out of dock for a long time, have until within the last few weeks been very remote from the tropical waters where these growths are so prevalent, and consequently they probably have much cleaner bottoms, and will be better able to maintain something approximating the rate of speed for which they were designed. This speed in itself is considerably higher in the case of nearly all the ships than is the speed of the Russian vessels, hampered as the latter squadron is by the accompaniment of a number of ships of old pattern and low speed; and the result is that Admiral Togo should be able to accept or decline battle at will, provided he is not called upon to directly defend any of the home ports in Japan.

As the Russians have no means of coaling, now that they are in the China Sea, other than from the colliers which accompany the fleet, some authorities have expected reports to the effect that Togo had let loose his destroyers upon these colliers in order to make it impossible for the Russian squadron to remain longer at sea, or to accomplish much of anything in the way of offensive work. It seems probable, however, that Rojestvensky is quite awake to the situation, and will use every endeavor to protect the colliers, and thus in fact maintain his "communications."

Both squadrons have a considerable number of protected and unprotected cruisers, together with torpedo-boat destroyers, but as ships of this class are totally unable to cope with the heavier fighting vessels, they could be available simply as scouts, or for minor actions not affecting the general result of the campaign. The Japanese considerably outnumber the Russians in ships of these classes, but it is well to note that among the Russian ships is one of the 25-knot cruisers of the *Nowik* class, which is so much faster than anything the Japanese can pit against it that the Russian service in this particular may perhaps prove to be superior to that of their opponents. As soon, however, as the Russian squadron reaches the immediate vicinity of Japan, if that vicinity ever is reached, the Japanese will be able to employ a very considerable squadron of torpedo boats of the smaller types, and her scouting abilities be much improved as compared with what they are at present.

It being quite apparent to outside observers that upon the results of the decisive battle which appears so imminent depends in no small measure not only the future of the present war, but the very future of the Japanese empire, the daily trend of events is being watched with the utmost interest, not only by professional naval and military men and engineers, but by the public at large. Should the Russians succeed in their endeavor to cripple Togo's fleet, it would result immediately in the transference to them of the command of the sea, now held so long by Japan; and would operate at once to isolate the Japanese army on the main land of Asia, cut their line of communications, and perhaps force Japan to make peace on Russia's own terms. If, on the other hand, Togo can succeed in either destroying the Russian squadron, or so neutralizing it as to prevent its menacing the Japanese line of communications, then the land campaign, which has occupied so much attention during the last few months, will be the one which will probably be decisive of the result of the war. In either event, the probability is that directly upon the issue of the naval conflict will depend the question of peace, and the ultimate outcome of a titanic struggle which has been almost without parallel in the annals of history.

A Serious Menace to Navigation.

Several times recently it has been discovered that a ferryboat has left her slip without showing the customary and necessary red and green lights on her port and starboard bows, respectively. Not only this, but the lights did show at the other end of the ship, where they had been set for the previous passage. The danger attendant upon this sort of thing needs no emphasis. Passing craft are accustomed to call attention to such a deficiency by a "two-two" whistle, but it might well be that a serious collision would result before this whistle signal had produced the desired result of procuring a proper setting of the lights.

To obviate the possibility of a mistake of this character some of the newer of the ferryboats plying in New York waters, which are electrically lighted, are fitted with a device by means of which the steering-wheel cannot be unlocked without throwing a switch which makes the necessary contact for setting the forward lights; while at the same time the lights at the other end of the boat are extinguished automatically by the same movement which locks that wheel in place. So necessary is it that this matter be made independent of the human factor—of the "personal equation" of the captain—that legislation is recommended, making compulsory the use of some such automatic device. The question is one of great importance, and of very lively interest to all whose business it is to be afloat in the harbor at night.

ABSTRACTS FROM RULES AND REGULATIONS OF THE AMERICAN BUREAU OF SHIPPING.

EDITION OF 1904.

ARRANGED BY HARRISON S. TAFT.

PART III.

7. When the main longitudinals do not extend into a boiler or engine room space, the auxiliary girders in said spaces should lap at least 3 frame spaces over the regular longitudinal girders, so as to maintain the longitudinal strength of the ship.

8. When the inner bottom plating is worked in and out the liners under the upper strakes should be left short, so as to provide means for ventilating said bottom. With flush plating, holes must be provided well up in the floors and longitudinals for the same purpose.

9. Water-tight floors should be fitted under all water-tight bulkheads.

10. Wooden ceilings when used are to be at least 2 1-2 inches thick. When not used the steel plating is to be 7 pounds heavier than otherwise.

11. Double bottoms should be tested with a head of water 2 feet above the deep load-water line.

12. When brackets are flanged in place of using angle clips, said brackets are to be 2 pounds heavier than otherwise.

28. Hatch Ways and Deck Openings.

1. All freight, engine, and boiler openings on a weather-deck should have plate coamings of not less thickness than the beams to which they are connected.

2. The boiler and engine hatch coamings in steam vessels, where the upper deck is not a hurricane deck, are to stand at least 3 feet above said upper deck planking unless a deck house is fitted over said openings, in which case the height can be 24 inches. When of said 24 inches in height, the weight of the coaming plate is to be not less than 14 pounds for vessels whose second number is under 16,000; and not less than 16 pounds when said number is or above 16,000.

3. The coamings of an engine or boiler opening on a hurricane, bridge, or full poop deck are to stand at least 18 inches above said deck planking.

TABLE 15.—UPPER-DECK FREIGHT HATCH COAMINGS. FORE-AND-AFT CARLINGS FOR HATCH COVERS.

Length of Hatch in Feet.	Height of Coamings Above Deck Planking.	Thickness of Coamings.
Not over 12	1½ times depth of deck beams to which they are secured.	2 lbs. less than thickness of deck beams to which they are secured.
Over 12 " " 16	Twice depth of deck beams to which they are secured.	Equal to thickness of deck beams to which they are secured.
" 16 " " 20	2½ times depth of deck beams to which they are secured.	2 lbs. heavier than thickness of deck beams to which they are secured.

Width of hatch in feet	Under 9	9 not over 12	Over 12, not over 16	Over 16
Number of fore-and-aft carlings to support hatch covers.	1	a. 2 or 3	3	Plans to be submitted for approval.

a. Two carlings when hatch covers are made full width of hatch; otherwise three carlings.
This table does not apply to hurricane-deck vessels.
Plans of hatches over 20 feet in length; or in width more than ⅜ the beam of the deck in way of said hatch on which they are fitted, must be submitted for approval.
When wooden carlings are used the middle one is to be at least 8 inches × 10 inches: side carlings, 7 inches × 6 inches.
Supporting collars with at least 3 square inches of rivet area are to be fitted at each end of the hatch cover carlings.

4. The coal-scuttle hatches on a weather deck are to stand above the top of the decking at least the depth of the main deck beams.

5. The coamings of freight hatches on the second deck of a hurricane-deck vessel need not exceed 18 inches above said deck planking. In other respects they are to be like the upper-deck hatches.

6. Freight hatches over 12 but not over 20 feet in length are to have a portable beam at mid-length, extending from the under side of the coaming plates to the under side of fore-and-aft carlings which support the hatch covers, and are to support said carlings for at least 5 inches of their length.

7. Hatch-coaming deck angles are to extend 1-2 inch above the deck planking.

8. Hatches on the upper decks, second decks of hurricane vessels, are to have rounded corners.

29. Hatch Covers.

They must be at least 3 inches thick. Hatch bars are to be at least of 4-inch by 1-2-inch iron; the wooden battens at least 8 inches by 2 inches. See Table 15 for hatch carlings.

30. Deck Houses and Engine Casings.

1. The plating of a deck house over the engine and boiler room deck openings of all vessels, except in hurricane-deck vessels, is to be at least of 8 pounds when the second number is under 16,000 and said deck house is not over 10 feet wide, or the combined length of said deck openings is not over 24 feet. When either of these two dimensions are exceeded, or the second number is 16,000 and under 25,000, a 10-pound plate is to be used. When said number is 25,000 and above, the plating is to be at least of 12 pounds. The stiffeners are to be equal to the reverse bars and be spaced 30 inches apart.

2. Deck houses fitted on a hurricane, bridge, or full poop deck over the engine and boiler openings, if not over 10 feet in width or 24 feet in length, are to be of 8-pound plate with 2 1-2-inch by 2 1-2-inch angle stiffeners. If said house is over the above 10 or 24 feet, 10-pound plating with 3-inch by 3-inch angle stiffeners is to be used. The stiffeners are to be spaced not over 30 inches apart. 4-inch by 3-inch stiffeners are to be used with all plating over 10 pounds.

3. Engine and boiler casings between decks are to have coaming plates standing 18 inches above the deck planking and they are to equal the thickness of the beam to which they are attached, but they need not exceed 16 pounds. Casing plating above the coaming is to equal that of the upper part of a water-tight bulkhead; stiffeners equal to reverse bars are to be spaced not over 30 inches apart.

31. Masts, Yards, and Bowsprits.

1. LOWER MASTS. (*a*) When under 24 inches in diameter at the partners they are to be built of two strakes of plating; but if 24 inches or over, of three strakes. Plating at the partners is to maintain its specified weight for 1-2 the length of the mast above and below the partners respectively. The weight of the topmast plating at the heel is to extend for 1-2 the length of said topmast above the heel.

(*b*) The plating at the partners must be doubled above and below the wedging for at least a distance of 1 1-2 times the diameter of the mast at the partners.

(*c*) There must be three rows of stiffeners in the lower masts dividing the circumference equally. If the lower mast is 45 feet or over from the partners to the hounds the stiffeners must extend the entire length of the mast. If said length is less than 45 and not under 35 feet, the stiffeners are to extend from 1-5 the tabulated length from below to 3-5 of the tabulated length above the partners. If said length is under 35 feet they need only extend from the lower edge of the doubling plates at the partners to 2-5 the tabulated length above the partners.

(*d*) All masts should be doubled in way of the lower mast caps and at the fid holes.

2. When the mast of a steamer or of a fore-and-aft rigged sailing vessel is made in one length, and the length from the lower mast partners to the lower mast hounds is 30 feet or more, the stiffeners are to extend above the lower mast hounds at least twice the diameter of the mast at the partners. Doubling plates are to be worked at the hounds.

3. BOWSPRITS.

The plating should be worked in three strakes when the diameter at gammoning is 24 inches or above. The weight of plating at gammoning is to be carried outboard and inboard of gammoning 1-2 of said respective lengths. There should be a stiffening bar extending from cap to heel at the center of each strake. Doubling plates, in length twice the diameter of the bowsprit at gammoning, should be worked at gammoning. When the sprit is 28 inches or over in diameter at gammoning there should be a vertical web plate inside, equal to the thickness of the plating at gammoning extending outboard and inboard 1-3 of said respective lengths.

4. YARDS.

They are to have doubling plates at the slings, said plates being in length not less than three times the diameter of the yard at slings. They should maintain their center weight of plating for 1-4 length of yard on each side of the slings.

32. Sluice Valves, Etc.

1. They should be fitted to all bulkheads except the forward collision bulkhead, with a rod running to upper decks. The forward collision bulkhead is to have a brass stop cock.

2. Sounding pipes are to be galvanized, with doubling plates located under same. They should be fitted to each water-tight compartment.

3. Bottoms from the keel to the bilges should be cemented. Thickness of cement should be such as to cover the heads of all frame and inside strake butt-strap rivets. The top of the inner bottom plating should also be cemented.

4. All sea suction pipes should have stop cocks or valves at the shell plating.

5. Upper-deck scuppers are to discharge overboard. Lower-deck scuppers are to drain into the bilge. Soil pipes extending below the load water-line are to be of iron or steel below said water-line and have shut-off valves.

6. Ventilators of suitable size are to be fitted so as to properly ventilate all spaces not ventilated by skylights, side ports, etc.

33. Wooden Decks and Ceilings.

1. When a wooden deck is laid on an all-fore-and-aft steel deck and the second number is not over 25,000, it may be 1-2 inch less in thickness than otherwise called for; that of a weather deck being not over 3 inches thick and that of a lower deck not over 2 1-2 inches thick.

2. Hurricane, full poops, and bridge decks are to be not less than 2 1-2 inches thick. Lower decks and topgallant forecastles are to be not less than 3 inches thick, when the second number is 10,000 and over, but when said number is under 10,000 the decks may be not less than 2 1-2 inches thick. The planks should not be over 6 inches wide.

3. Upper deck planking, second deck in hurricane-deck vessel, topgallant forecastles, and all margin planks are to be fastened with galvanized bolts through the beams. Hurricane decks, full poops, and bridge decks are to have galvanized screw fastenings to the beams.

4. All decking is to be renewed when reduced to 3-4 of its original thickness.

5. The margin or sheer planks are to be of southern pine, at least 7 inches wide and 1-2 inch thicker than the deck planking.

6. The sides of the cargo holes and between-deck spaces are to have wood battens 2 1-2 inches thick secured with galvanized bolts and nuts to the reverse bars. The bilges are to be close ceiled.

34. Steering Gear.

1. Diameter of chains is to be obtained by the formula:

$$d = .4\sqrt{\frac{D^3}{R}}$$ where D = the diameter of the rudder stock;

R = the radius of the quadrant; and d = the diameter of the chain iron; all in inches.

2. Rods, when used, are to be 1-4 larger in diameter than chains.

3. Sheaves are to have a pitch diameter of at least 15 times the diameter of the chains. Diameter of their pins is to be not less than twice the diameter of the chains.

35. Rudders.

The plates of side-plated rudders are to equal in weight the lower plates of bulkheads, with wool filling between them. All rudders are to be arranged so they can be unshipped when the vessel is afloat.

36. Lifeboats.

TABLE 16.—NUMBER OF LIFEBOATS.

Second number.....	Under 5,000	5,000 under 8,500	8,500 under 16 500	16,500 and above.
Number of boats.....	1	2	3	4

Vessels of American Register must have lifeboats and other equipment according to the United States statutes.

37. Three-Deck Vessels.

1. Said vessels are to be of 18 feet or more in depth, having two or more complete tiers of decks, with hold beams.

2. The sheer strake is to be fitted at the upper deck.

3. Butts of the sheer strake, of the upper-deck stringer, and of at least two bilge strakes, are to be treble riveted for 3-5 length amidships.

4. Engine and boiler casings are to extend from the second to the upper deck.

38. Hurricane-Deck Vessels.

1. The main sheer strake is to be worked at the second deck with an auxiliary sheer strake at the hurricane deck. Coastwise vessels may have their hurricane-deck sheer strake and the shell plating between the hurricane and the main deck of less weight than for an ocean-going hurricane-deck vessel.

2. Tie plates are to be fitted on the hurricane deck; with a reduction in width of same for a coastwise vessel.

39. Full Poops, Enclosed Bridge Houses, Topgallant Forecastles.

1. Second number under 16,500.

(*a*) When the length of said poop or forecastle deck exceeds 1-5 the length of the vessel, the main-deck sheer strake at front of said poop and at aft end of said forecastle is to be increased by 4 pounds for a distance equal to 1-2 the vessel's breadth.

(*b*) When the combined length of said poop and bridge house, of said poop and forecastle, or of said poop, bridge house, and forecastle exceeds 1-2 the vessel's length, the said increase of 4 pounds is to extend for 3-4 length amidships.

2. Second Number 16,500 or above.

(*a*) In place of a 4-pound increase, as above, the sheer strake is to be worked double for the respective distances of 1-2 breadth and 3-4 length amidships.

(*b*) The doubling of the sheer strake is to equal the weight of the strake next below the sheer strake, and is to extend from the upper edge of said strake to the main-deck stringer. The thickness of the enclosed bridge-house plating is to be maintained for 3 frame spaces forward and aft of the ends of said bridge house.

3. Tie plates are to be worked on a topgallant-forecastle and bridge-house deck when the vessel's breadth exceeds 20 feet. They are to be worked on a full poop deck which exceeds 1-5 of the vessel's length or which is 20 feet or more in width at the forward end of said poop deck.

4. Sheer strakes of a topgallant-forecastle or enclosed bridge house whose length is or over 1-5 the vessel's length, and of a full poop whose length is or over 1-4 said length, are to be 2 pounds heavier than the side plating of their respective deck enclosures.

5. When rounded gunwales are used, the gunwale bars on these decks are to be worked so as to form a margin for the deck planking.

40. Raised Quarter and Fore Decks.

1. The scantlings of said decks are to be the same as for a main deck.

2. When the length of a raised quarter deck exceeds 1-4 the vessel's length the depth for determining hold stringers and beams under said decks is to be taken to the top of said deck at its forward end.

3. When the length of a fore or raised quarter deck exceeds 1-4 the vessel's length, the main-deck stringer is to maintain its full width throughout, and must taper for at least 6 frame spaces beyond the break at both ends of said deck to moulding of the frame at its ends. It shall be clipped to the shell. The quarter and fore-deck stringers are also to extend beyond the breaks a sufficient distance to maintain the strength of the vessel.

4. The doubling or increasing of the weight of the main sheer strake is to be the same as for a poop, enclosed bridge, or topgallant-forecastle deck, as above.

5. Raised quarter decks (except when same is worked over the engine and boiler spaces), not over 1-4 the vessel's length, and raised fore decks not over 1-5 the vessel's length need not be plated.

6. Steamers with their machinery placed amidships and with a raised quarter or fore deck, either of which exceeds 1-5 the vessel's length, requiring a steel deck, are to have said deck extending all fore and aft, with bracket plates, or otherwise at the breaks. If said length is under 1-5, the steel deck need not extend beyond the breaks, but the above bracket plates must be fitted at the breaks.

7. When no steel deck is laid on the main deck, one beam space at the ends of a raised quarter, fore deck and enclosed bridge house is to be plated over from stringer to stringer.

8. Plates for securing the ends of the wooden deck are to be worked on the beams at the ends of a raised quarter, bridge house, and fore deck.

9. Sheer strakes at the raised quarter and fore decks are to equal those of the strake next below the main sheer strake, when said strake is not over 14 pounds. If the above said strake is 15 pounds, the raised quarter and fore decks' sheer strakes are to be 1 pound less than said strake, but 2 pounds less if said strake is 16 pounds or over.

41. Freeboard.

TABLE 17.—FREEBOARD.

Depth of hold from top of ceiling to under side of main deck; (second deck in hurricane-deck vessels). Feet...	8	10	12	14	16	18	20	22	24	26	28	30
Freeboard at lowest point of sheer. Inches.....	12	20	27	31½	40	49⅜	60	71½	78	91	98	112⅜

The freeboard is to be measured from the actual load water-line to the main-deck stringer (second deck in hurricane-deck vessel) at the lowest point of the sheer.

The minimum freeboard for hurricane-deck vessels may be not less than ½, and for raised quarter-deck vessels not less than ¾ of the above freeboard.

42. Spacing of Rivets.

	Dias.
1. Longitudinal laps and edges of shell plating and of all other plating required to be calked water-tight:	
20 pounds and under	4
Over 20 pounds	4 1-2
Center to center of rows	2 3-4 to 3
2. In all butts, except third row of a treble-riveted butt	3 1-2
Center to center of rows	2 1-2 to 3
3. Third row of a treble-riveted butt, except otherwise stated	7
4. Bar keels, stems, stern frames	5
Center to center of rows	2 1-2
5. Laps or edges of water-tight bulkheads; longitudinal laps or edges of a steel deck; longitudinal laps or edges of the inner bottom plating; gunwale bars and similar water-tight work	4 1-2
6. Water-tight frames to shell and bulkheads	5
7. Ordinary frames to shell and floors; reverse frames; stiffeners on all bulkheads, engine and boiler casings, shaft tunnels, and deck houses; all stringer plates and deck plating to deck beams; all keelsons and stringer angle bars; and, in general, where water-tight work is not required	7 1-2

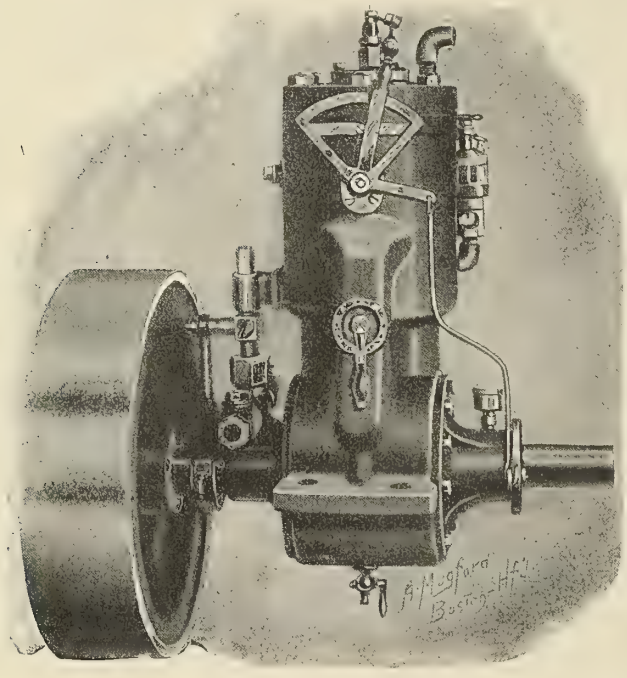
TABLE 18.—AMERICAN BUREAU OF SHIPPING. WIDTH OF BUTT LAPS AND BUTT STRAPS. SPACING OF RIVETS.

	Width of Plate in Lbs.	Diametral Pitch.	10	12½	15	17½ to 20	22½ to 27½	30 to 35	37½ to 40
	Diameter of Rivets in Inches.		9/16	5/8	11/16	¾	⅞	1	1⅛
Width of.	Single riveted butt laps	3½	2	2 3/16	2⅜	2⅝	3 1/16	3⅛	3 1/16
	Double " " "	....	3¾	4⅛	4⅛	5	5¾	6½	7¼
	Treble " " "	....	5½	6	6½	7	8¼	9½	10¾
	Double " " straps	....	7	7¾	8½	9½	11	12½	14
	Treble " " "	....	10½	11½	12¾	14	16⅛	18½	21
	single " " seam laps	....	2	2¼	2⅜	2⅝	....	....	....
	Double " " " "	6	3½	3¾	4	4½	5¼	6	6¾
	Single " " edge strips	....	4	4½	4¾	5½	6¼	7	8
	Double " " " "	12	6¾	7½	8¼	9	10½	12	13½
Spacing of rivets.	1.—All butts except third row of a triple riveted butt	3½	2	2 3/16	2⅜	2⅝	3 1/16	3½	3 1/16
	Center to center of rows	2½ to 3	...	...	...	...	....	....	....
	2.—Laps and edges of the shell and all other plating required to be caulked. Not over 20 lbs.	4	2¼	2⅝	2¾	3	3½	4	4½
	Over 20 lbs.	4½	2⅝	2 3/16	3 1/16	3⅜	3 5/16	4½	5 1/16
	Center to center of rows	2¾ to 3	...	...	...	...	....	....	....
	3.—Seams of water-tight bulkheads; of steel decks; of the inner bottom plating; and of all similar work	4½	2½	2 13/16	3 1/16	3⅜	3 15/16	4½	5 1/16
	4.—Bar keels; stems; stern frames	5	2 13/16	3⅜	3 15/16	3¾	4⅜	5	5⅝
	Center to center of rows	2½	1⅜	1 9/16	1 11/16	1⅞	2 3/16	2½	2 13/16
	5.—Water-tight frames to shell and bulkhead plating	5	2 13/16	3 1/16	3 15/16	3¾	4⅜	5	5⅝
	6.—Third row of a triple riveted butt; unless otherwise stated	7	3 15/16	4⅜	4 15/16	5¼	6⅛	7	7⅞
	7.—Ordinary frames to shell and floors; reverse bars; all bulkhead stiffeners; all keelson stringer bars; deck beams and deck plating; deck houses and all similar non-water-tight work	7½	4 3/16	4 11/16	5⅛	5⅝	6 9/16	7½	8 7/16
Spacing of rivets. Oil tanks only.	1.—Single riveting of laps and angles for oil-tight work	3	1 11/16	1⅞	2 1/16	2¼	2⅝	3	3⅜
	2.—Double chain riveting	3¼	1 15/16	2	2¼	2 5/16	2 13/16	3¼	3⅝
	3.—Double zigzag riveting for oil-tight work. Each row	4	2¼	2½	2¾	3	3½	4	4½
	4.—Middle line keelson angle bars; clips connecting the side stringers and keelsons to the shell plating. Single riveted	3¼	2 1/16	2 5/16	2 9/16	2 13/16	3 1/16	3¾	4 1/16
	Double and zigzagged.	4¼	2⅜	2 10/16	2 15/16	3 3/16	3 11/16	4¼	4¾
	5.—All bracket plates; beam knees; non-water-tight clips; clips not connected to the shell plating. Single riveted.	4	2¼	2½	2¾	3	3½	4	4½
	Double and zigzagged.	5	2 13/16	3⅜	3 15/16	3¾	4⅜	5	5⅝
	6.—Ordinary frames to shell plating; reverse bars to floors and frames; deck plating to beams; bulkhead and expansion tank stiffeners when not caulked; keelson and stringer running angles when not caulked; web plates to the frames; deep frames to frames. Single riveted.	6	3⅜	3¾	4 1/16	4½	5¼	6	6¾
	Double and zigzagged.	7½	4 3/16	4 11/16	5⅛	5⅝	6 9/16	7½	8 7/16

ENGINEERING SPECIALTIES.

Lawrence Two-Cycle Marine Engine.

Designed for a maximum of simplicity, this engine is built in three sizes, 1 1-2, 3 and 5 horsepower, and operates at respectively 450, 450 and 425 revolutions per minute. The general construction is well shown by the illustration. It may be said in



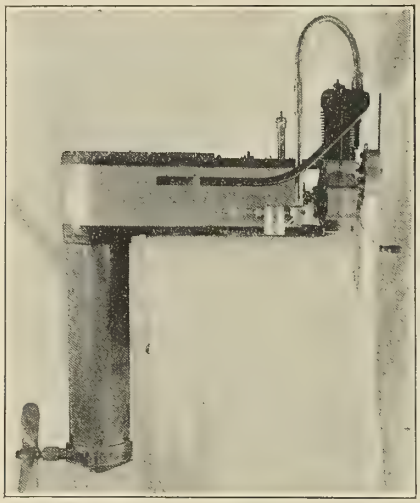
general, however, that the crank shaft may be readily removed without disconnecting anything but the connecting rods, and that all wearing parts are provided with simple and ready means of taking up wear and to avoid disturbance through wear of the alignment of the working parts. The engine is built by the Lawrence Machine Company, Lawrence, Mass.

The Raabe Motor for Boats.

The box-shaped frame contains the gasoline tank, as well as the battery and spark coil. To the inboard end of the frame the motor is attached, while the other end carries the elliptical column, with the propeller at its lower end. The motor shaft and propeller shaft are connected by means of a sprocket chain of fine pitch, making the transmission very efficient and noiseless.

The propeller shaft is made of phosphor bronze with extra long bearings, and is supplied with a ball thrust bearing of hardened tool steel, the sprocket and chain being also made of hardened tool steel. The lower sprocket as well as the thrust bearing and propeller shaft bearing run submerged in oil and graphite, and as the chain constantly carries an amount of oil and graphite upwards, the upper sprocket and its bearings are also constantly lubricated.

Leakage is prevented by means of a stuffing box of extra depth, and the stuffing-box gland is prevented from turning by a jam nut. The carburetter is of the constant level type of novel design supplied with a needle valve which admits very fine adjustment. The starting crank is at the inboard end of the motor and does not revolve when the engine is running.

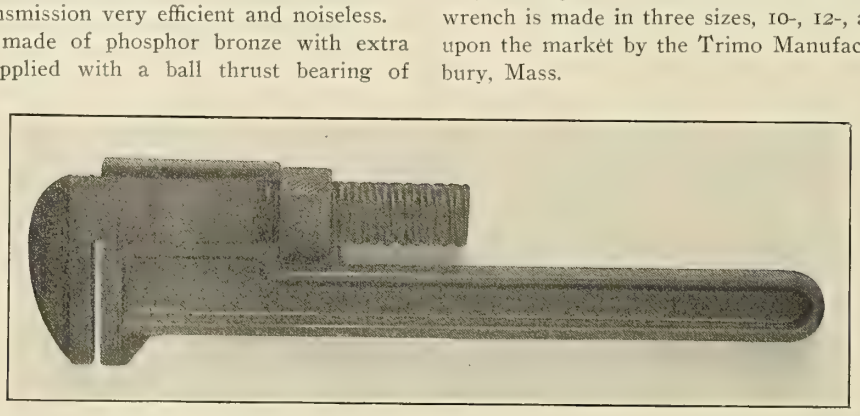


The entire two-horsepower outfit illustrated weighs only 50 pounds, and will contain enough fuel to supply the engine for ten hours' steady running; an additional storage may be kept in an oil can in the boat. On account of the light weight, this machine is extremely well suited as auxiliary power for sailboats, but any rowboat can easily be converted into a launch by setting this machine into the stern.

All parts coming in contact with the water are made of phosphor bronze, the frame being made of steel heavily galvanized, and the crank case of aluminum; the only cast-iron part is the motor cylinder.

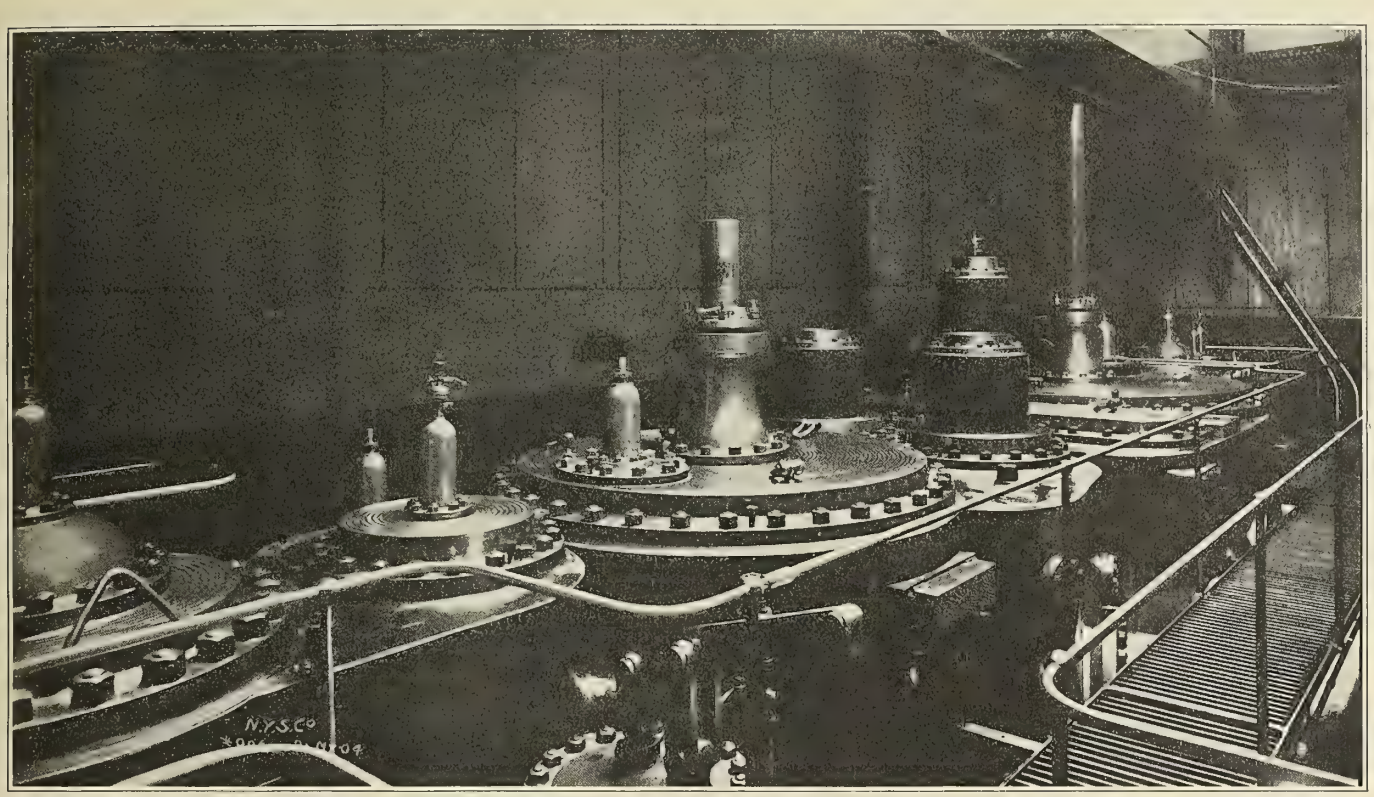
The Trimo Wrench.

Made of three parts, all of which are of forged steel and case hardened, this wrench is constructed for strength and hard usage. The threads of the jaw and of the nut are rounded like the Whitworth thread, rendering them impervious to bruises or other causes to interfere with their proper working. In direct contrast with the usual monkey-wrench, this wrench, as will be seen from the illustration, increases its leverage with increasing size of nut, as the jaw is extended forward instead of drawn back. The wrench is made in three sizes, 10-, 12-, and 15-inch, and is placed upon the market by the Trimo Manufacturing Company, of Roxbury, Mass.



Balance Cylinders.

The purpose of a balance cylinder is to neutralize the forces set up by a reciprocating body. It should be so designed that these forces meet equal and opposite forces in the balance cylinder instead of transmitting them in the shape of pressure to the crank shaft or whatever other device is used to impart the reciprocating

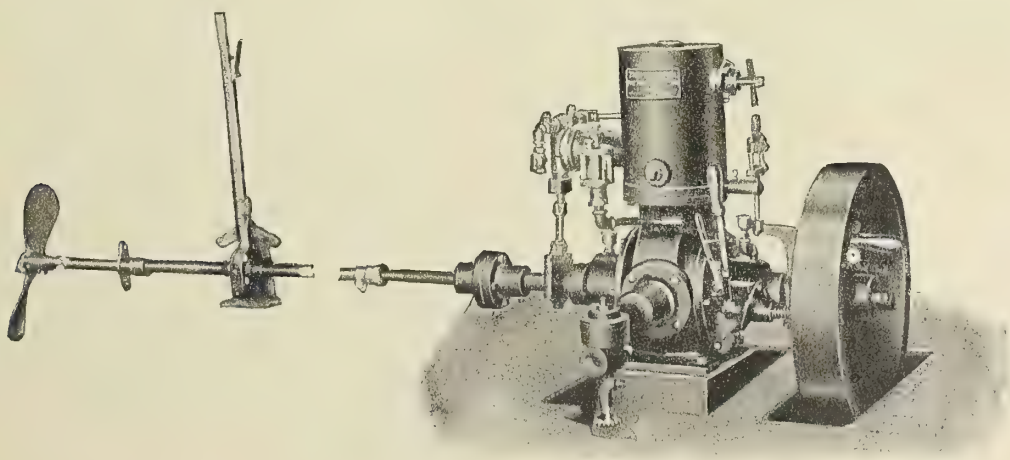


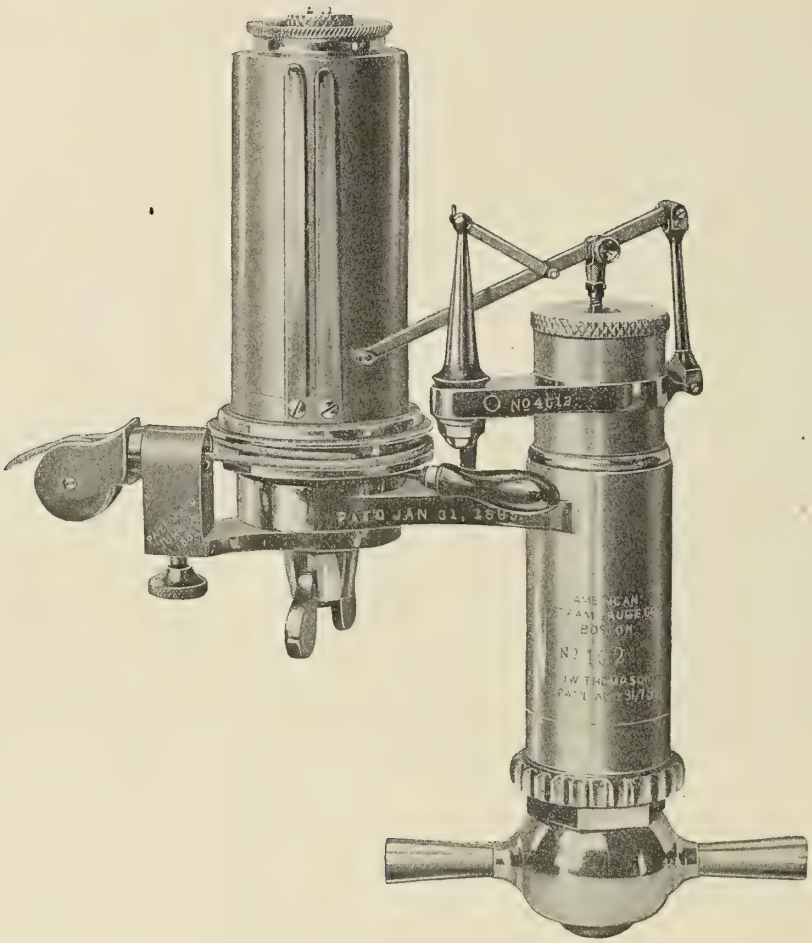
motion. This is a subject which has hitherto received little attention from scientific designers; in fact, the only field to which these cylinders have been applied is that of valve gears, and in this it has been done so crudely that the cylinders are really not balance cylinders at all, for they neglect the most important force developed by the reciprocating body. An exception to this is the Lovekin-Thom assistant cylinder, the theory of which was first set forth in a paper read before the Society of Naval Architects and Marine Engineers in November, 1902.

The function of a true balance cylinder is to act as a spring or dashpot at the end of each stroke. The energy expended in compression is returned in expansion, so that theoretically the reciprocating motion could continue indefinitely and without the consumption of steam or other outside source of power. This theory has been applied by the New York Shipbuilding Company to the low-pressure cylinders on the steamship *Manchuria,* which was recently put into service on the Pacific. The actual results as taken from indicator cards show that practice approaches very nearly to the theoretical conditions. We present reproduction of a photograph showing the upper part of the engine room of the *Manchuria,* with assistant cylinders in place.

The Wizard Marine Gasoline Engine.

We present an illustration of the Wizard engine and propeller, which is stated to be ideally adapted to marine use. Equipped with a patent speed changing device, the rate of rotation may be very quickly changed to anything between 200 and 1,200 revolutions per minute without the necessity of changing the position of the spark or the mixture of the gas. This enables the power of the motor to be varied from 1 to 6 horsepower. A governor is fitted, which, in connection with the changing device, will automatically maintain within the limits of the stated power any required rate of speed. A reversing clutch is fitted, which obviates the necessity of reversing the blades of the propeller, and thus conduces to increased efficiency in the latter. The weight of the engine is about 225 pounds. The propeller is of the three-blade pattern with a diameter of 14 inches. The engine is adapted to launches up to a length of about 22 feet. It is manufactured by the Temple Pump Company, of Chicago.





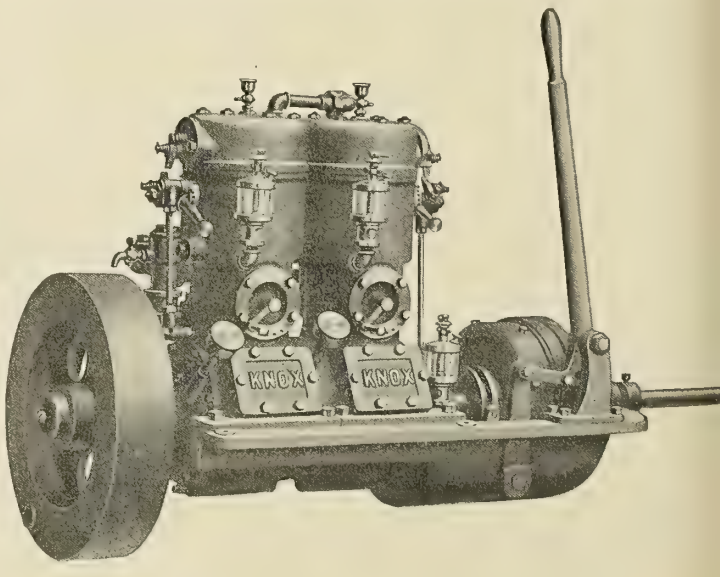
Indicator for Gas Engines.

In order to meet the requirements in adaptability to high speed and high pressures imposed by gas engine practice, the American Steam Gauge and Valve Manufacturing Company, of Boston, have brought out the modification of their Thompson indicator shown in the accompanying engraving. The piston is reduced to one-quarter inch area, which doubles the capacity of the spring and makes the working of the instrument more steady under the high pressures and sudden shock to which it is subjected in this class of work. When desired, a piston one-eighth of an inch in area is furnished in connection with this instrument. This adapts the instrument to the exceptionally high pressures met with in gas engine practice. A special mixture of metal is used for the cylinders, with a view to obtaining an even movement of metal under the severe ranges of temperature and strain.

The diagram reproduced herewith was taken with one of these indicators with a 1-8-inch piston, with a spring which scales 150 when used with a 1-2-inch piston, but which with the smaller piston scales 600. The pressure was about 600 pounds and the speed 230 revolutions per minute. The diameter of the paper barrel is reduced to 1 1-2 inches and it is provided with a specially strong spring, diminishing the difficulties of keeping its motion synchronous with that of the piston. It is provided with the detent motion described in our February issue, which finds a particular application in this field, where the speeds are usually so high as to make it difficult to hook and unhook the cord. The instrument is furnished without the detent motion, when desired, and in that form has been successfully used on recent tests at 975 revolutions per minute. The parallel motion and the working parts are also made as heavy as is consistent with accurate operation.

The Knox Marine Motor.

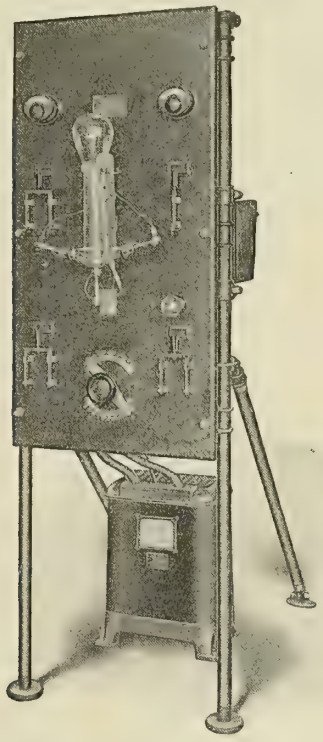
This motor is put on the market by the Camden Anchor-Rockland Machine Company, of Rockland, Me., and is of the two-cycle type, with the piston acting as a check valve, and the engine taking gas from the carburettor through a port hole in the cylinder under the exhaust port, which port hole is closed and opened by the piston on every stroke. The igniter is a plug easily removable and having adjustable firing points of the make-and-break pattern. The crank pin is oiled from a cup located on the outside of the cylinder, no oil being carried in the crank chamber. The builders



have a large foundry connected with their plant where all of the iron and composition castings for this engine are made. The crank shafts are heavy and are drop forgings. The engines are built in the one-cylinder pattern from 1 1-2 to 6 1-2 horsepower, and the two-cylinder engines from 5 to 13 horsepower.

Mercury Arc Rectifier.

In the exhibit of the Electric Launch Company, at the recent Motor Boat and Sportsmen's Show, was shown one of the General Electric Company's mercury arc rectifiers in full operation. It was used to charge forty-four cells of battery in the electric launch *Rest Awhile,* the current being 30 amperes at 110 volts,



direct current; the alternating current used is 220 volts, 60 cycles. This presents an interesting field for the use of mercury arc rectifiers, and it is probable that the use of electric launches may be materially increased because of the simplicity of the charging outfit now offered.

PERSONAL.

Mr. William Griscom Coxe, for many years guarantee engineer for William Cramp & Sons' Ship and Engine Building Company, has been elected president of the Harlan & Hollingsworth Corporation, Wilmington, Del.

Mr. W. A. Stadelman, for several years New York representative of the Brown Hoisting Machinery Company, has accepted the position as New York representative for the Wellman, Seaver, Morgan Company.

Mr. Richard Devens, who for some years has been connected with the European office of the Brown Hoisting Machinery Company, has been appointed manager of the New York office, 26 Cortlandt street, New York, N. Y.

Capt. John W. Collins, Engineer-in-Chief of the Revenue Cutter Service, has been granted a year's sick leave, and Chief Engineer C. A. McAllister has been appointed Acting Engineer-in-Chief.

Robert R. Livingston, M.E., formerly with Allis-Chalmers in their Chicago office, has associated himself with W. S. Barstow, consulting engineer, at 56 Pine street, New York city.

TECHNICAL PUBLICATIONS.

The Steam Engine. Vol. 1, The Thermodynamics and the Mechanics of the Engine. By Robert C. H. Heck, M.E. Pages 391 + 66; figures 190. New York: D. Van Nostrand Company. Price $3.50 net.

The object of this book is to set forth clearly the fundamental principles of the steam engine, to give a broad description of constructive practice, to explain fully the working of the apparatus in its several component parts, and to show how to obtain and improve its efficiency in performance. Intended to be used as a textbook for the use of students, it is, at the same time, designed as a complete engineering treatise, to be followed in Vol. II by a discussion of the form, construction and working of the engine, as well as several chapters devoted to the steam turbine. All mechanical and physical deductions are built up from basic foundations in order to render the book as much as possible self-contained. Many examples are given to illustrate the principles involved, and some use has been made of the calculus to develop the theories; graphical methods are very generally used as being in many cases much easier of comprehension than algebraic.

On the side of thermodynamics the purpose has been to present only what is essential to the theory of the steam engine as a working apparatus. The primary theory of the operation of a steam engine with a perfect gas is first built up before going into the properties of steam as used in commercial work. The working theory of the steam jet is given considerable attention, as well as the principles involved in the flow of steam in pipes and in the injector. A development of the entropy temperature analysis completes this division of the subject. At the back of the book are a number of tables of the usual sort to be found in a work of this character, principal among which, of course, is a table of the properties of superheated steam. The work concludes with a short discussion on superheated steam.

Boiler-Room Chart. By George L. Fowler. Size 14 by 28 inches. New York: Norman W. Henley Publishing Company, 1905. Price 25 cents.

This is an education chart, showing in isometric perspective the mechanisms belonging in a modern boiler room. The equipment consists of water-tube boilers, ordinary grates and mechanical stokers, feed-water heaters and pumps. Various parts of the appliances are shown broken or removed so that the internal construction is fully illustrated. Each part is given a reference number and this with the corresponding name is given in a glossary printed at the sides. The chart, therefore, serves as a dictionary of the boiler room, the names of more than two hundred parts being given on the list.

The Art of Generating Gear Teeth. By Howard A. Coombs. Pages 129 + 10; figures 37. New York: D. Van Nostrand Company, 1904. Price 50 cents.

This little book consists of a series of articles reprinted from the *American Machinist,* in which they first appeared, and carry the subject from the general theory of tooth curves into a discussion of the formation of gear teeth by machinery, and finally end with a rather complete description of new devices for generating gear teeth, and of forms of teeth other than the usual epicycloidal and involute teeth. It forms one of the Van Nostrand Science Series, and ought to have a considerable value for those who have in charge the designing of gear teeth and of machinery for cutting them.

Time Chart of the World. New York: Spon & Chamberlain, 1905. Price 25 cents.

This consists of a chart with all the important cities of the world placed around it in positions corresponding with their respective longitudes, and is fitted with a rotating member containing the hours of the day. This permits the hour at any given place to be immediately learned by putting the corresponding hour at the place of the observer opposite his corresponding longitude.

Report of the Merchant Marine Commission. In three volumes. Washington: Government Printing Office, 1905.

These three volumes contain a total of 1,985 pages of testimony taken before the meetings of the Merchant Marine Commission last year, and include in full all the opinions rendered by the myriads of experts on the subject, whom the commission consulted in the course of its labors. The first eighty-two pages, which are not included in the total number mentioned, are devoted to the report presented by the majority, that presented by the minority, the bills proposed by both parties, and a two-page index to the same. The last one hundred and three pages of the third volume are devoted to a most exhaustive index of the entire work, with the splendid cross index to the same so frequently met with in government reports, and so convenient for purposes of reference. Just previous to this index appear statements by several gentlemen especially qualified to speak on the subjects, regarding the operation of steam turbines, and the general question of coal economy of ships of various speeds. These statements were submitted to the commission after the regular sessions had closed, but have been incorporated in the report as supplementary to the main body thereof. Considerable attention is given to the question of fitting turbines to ships which are designed to go at speeds of less than 15 or 16 knots, a procedure which has been up to the present date considered out of the line of economical operation, because of the fact that the necessary rotative speed of the turbines would operate to produce an excessive slip in the propeller.

The report, as a whole, is a monument to the extensive character of the investigation undertaken, and should be carefully examined by everyone interested in this very live topic.

Ferric and Heliographic Processes. By George E. Brown, F.I.C. Pages 149; figures 20. New York: Tennant & Ward, 1905. Price $1.00.

This is the second edition of this book. It deals to a considerable extent with the making of blue and other prints by the various processes, and contains a number of formulæ for making printing papers of not only the blue-print type, but of brown and black lines on white grounds, together with samples of the papers as made. For the use of photographers and in drafting offices the book should be decidedly valuable.

A Class Book of Naval Architecture. By W. J. Lovett, Lecturer on Naval Architecture at Belfast Municipal Technical Institute. Pages 283 + 50; figures 173. New York and London: Longmans, Green & Company, 1905. Price 7/6 net.

This book is intended for class-room use, and represents the results of the experience of the author in his classes in the Municipal Technical Institute. The subject is taken up in the usual way, beginning with chapters on mathematics and the applications thereof, and running through the various ship calculations for displacement, center of buoyancy, stability, weight and stowage, trim, launching calculations, strength, etc., and this part of the work is followed by a chapter on laying off the lines in the mold loft, another giving a brief synopsis of the more important rules of Lloyd's Register, and of the British Corporation, and a further chapter regarding the actual construction of a ship, beginning with the preparation of the berth, the arrangement of the keel blocks and appliances, and the work necessary for the preparation of the various component elements of the ship and their incorporation in the structure. The last chapter is devoted to examination papers from the London Board of Education, together with useful tables of constants, logarithms, etc., and in the extreme rear of the book are a number of blank pages for notes and memoranda. While quite brief, it seems to cover a great deal of ground, and, when supplemented by the lectures with which it is doubtless designed to be associated, ought to be a splendid work on the general subject. Without these lectures it still forms an excellent work of reference.

A Text Book of Marine Engineering. By Engineer Commander A. E. Tompkins, of the Royal Navy. Pages 383 + 26; figures 266. Portsmouth: J. Griffin & Company; and New York: D. Van Nostrand Company, 1904. Price $6.00.

This is a comprehensive work on the subject indicated in the title, and starts with the usual definitions of the various component parts forming the machinery outfit of a ship, goes through the development of the design and operation of the various items involved, together with a discussion on the several types in vogue under each head, and ends with several chapters devoted to water-tube boilers, liquid fuel, and marine steam turbines. The book is the second edition of the work and has been considerably enlarged, and in part re-written, as compared with the first edition. A practical application of mathematics being essential to the design and economical working of marine machinery, use has been made of the principles of the calculus in bringing out some of the points touched upon; but, as the book is offered as a summary of the practice of the present day, and not so much a theoretical treatise, the reading matter has been made as simple as possible and the higher mathematics resorted to only where it was necessary to illustrate a point or develop a theory. One interesting feature of the book consists in the fact that all of the cuts are printed on insets on plate paper, which renders the work of considerably greater extent than is indicated by the mere enumeration of the number of pages.

The Steam Turbine. By Dr. A. Stodola, Professor at the Polytechnikum in Zurich; translated by Dr. Louis C. Loewenstein. Pages 434 + 66; figures 241. New York: D. Van Nostrand Company, 1905. Price $4.50 net.

This work was first published in 1903, as a serial in *Zeitschrift des Vereins Deutscher Ingenieure*, but has been very largely amplified before being published in book form. A considerable amount of important constructive details have been added, thanks to the assistance of many builders of the steam turbine; while much weight is given, of course, to the discussion of the scientific principles involved in this particular type of motor. The work is arranged in six sections, of which the first develops the elementary theory of the steam turbine by means of a discussion on adiabatic changes in the condition of steam and the flow of steam through nozzles. The second section discusses the theory of the steam turbine considered as a thermodynamic machine, and takes up the laws of energy as applied to the turbine. In the third section are given the details of construction of the more important parts of the machine, prominent among which are the blades and the methods of fastening the blades into the disks. The fourth section is devoted to a discussion of the various types of steam turbines, with considerable material on the De Laval, Seger, Riedler-Stumpf, Zoelly, Curtis, Rateau, Parsons, Schulz, Lindmark and Gelpke-Kugel turbines. This section concludes with a discussion of the marine steam turbine and a comparison between the steam turbine and the reciprocating engine. In Section 5 are taken up a number of problems connected with the theory and construction of the steam turbine, such as the automatic centering of the rotating member about its own center of gravity, the stresses in the disk wheels, the critical velocity of a shaft of varying diameter, and the gyroscopic action of a marine turbine. The sixth section is called an appendix, and is devoted to "The Future of the Steam Engine." It is a mathematical and theoretical discussion of the second law of thermodynamics, entropy, and the economy of the steam engine, together with some remarks on the gas turbine.

As might be readily expected in a book of German production, free use has been made of higher mathematics and algebraic demonstration. The cuts are very clear and seem to be splendidly adapted to the purpose in hand. In a pocket attached to the back cover are a number of entropy diagrams. The book as a whole should be of great use to designers and engineers interested in the development of the steam turbine, as well as to students in engineering colleges who are interested in the subject.

QUERIES AND ANSWERS.

Q.—280. The answer given to this question in the April issue has provoked considerable comment, due to the fact that, although there are no ferryboats operating from one side to the other on the East River, in which the paddles may be revolved in opposite directions, there is a boat, the *Maryland,* which takes the Colonial Express through the East River from Harlem to Jersey City, and in which the propellers are fitted as above mentioned.

There is also a ferryboat on the Piscataqua which is similarly fitted. A large ferryboat in operation in San Francisco harbor is also so arranged that the paddlewheels may be rotated in opposite directions. We presume that there may be a few other scattered examples, but they are quite rare.

Q. 274.—Would you kindly inform me, through your Q. & A. column, how to figure out the displacement, curve of buoyancy, and stability of a modern design of yacht?

I have tried Simpson's rules but they don't seem to work, as each waterline is so much shorter or longer than the one above or below it, hence the spacing of the ordinates for calculation on a displacement sheet seems impossible. A. H. S.

A.—The article beginning on page 198 will fully answer the above query.

Q. 283.—I want to put a gasoline engine in a flat-bottom fish-boat, 34 feet long, 10 feet wide; will draw about 16 inches loaded. The speed wanted is about 6 miles per hour.

(1) How many horsepower required in the engine?
(2) How many revolutions?
(3) How big a wheel?
(4) What pitch?
(5) Single or double cylinder?

J. F.

A.—The data does not give us the displacement of this boat, but assuming from the general conditions of the case that the model is quite full, we have taken the block coefficient as .7, which gives a total displacement of 9.08 gross tons, or 20,320 pounds.

(1) The horsepower is found from the formula:

$$H = \frac{D^{\frac{2}{3}} V^3}{K} = \frac{4.35 \times 216}{160} = 5.88.$$

We have assumed the Admiralty coefficient as 160, and thus obtain the horsepower given, which may be roughly placed at 6.

(2, 3, 4) These three questions are so interrelated that it is best to work them out together. With this end in view, we have computed the size of propeller and revolutions in accordance with the formulæ given on page 115 of Marine Engineering for March. We have taken the slip-ratio as 25 percent, which gives factor $b = .82$. The fact that the Admiralty coefficient is taken as 160 gives us factor $a = 1.23$. The pitch-ratio has been assumed as 1.1, which gives factor c as .90, and we have assumed that the propeller is of a standard pattern, so that factor e will be unity. On this basis:

$$d = .9 \times 1.23 \times 82 \times .90 \times 1 \times \sqrt[3]{20,320} = 22.3,$$

which we will call 22 1-4 inches. The pitch will be 1.1 times this figure, or 24.5 inches, which equals 2.04 feet. The number of revolutions will be:

$$\frac{6 \times 88}{2.04 \times .75} = 345.$$

(5) As marine gasoline engines are now built, an engine of 6 horsepower would probably call for a single cylinder only.

Q. 281.—Will you please inform me what relation or proportion the air-pump cylinder volume has to the (H. P. or) L. P. cylinder volumes in *modern* compound-, triple-, and quadruple-expansion marine engines? Is this relation different for direct-connected, independent, single-acting, vertical-beam, and the later double-acting, "suction-valveless" or feather-weight types? Also, what is the ratio of the air-pump displacement to the feed-water volume for these various types. X. Y. Z.

A.—There is probably no item of marine design in which there is so much variation as in the relation of the size of an air pump to either indicated horsepower or size of low-pressure cylinder. For vertical single-acting pumps used in connection with compound, triple-expansion and quadruple-expansion engines the displacement volume per minute is found on the average to be about .2 cubic foot per I. H. P. Thus, for a 1,000-horsepower engine the displacement volume per minute should be about 200 cubic feet. Then, if single-acting, and making 100 double or 50 effective strokes per minute, the volume for one stroke should be 200 ÷ 50 = 4 cubic feet. For double this speed, or 100 effective strokes, the volume should be 2 cubic feet. While this figure represents an average, actual practice varies over a wide range, general experience showing that a much smaller pump if in good condition will maintain a good vacuum, but will require a longer time in which to develop it. The ratio may thus vary from as little as .06 cubic foot per I. H. P. to .25 cubic foot.

If, on the other hand, we refer the size of the pump chamber to the low-pressure cylinder, we find that this relation has no meaning unless the relative number of strokes is also taken into account. If the pump is attached, the number is the same, and we have one effective stroke per revolution. On this assumption the volume of the pump may be taken from about 1-18 to about 1-30 of the volume of the low-pressure cylinder. One-twentieth to 1-25 will give values agreeing fairly well with good average practice.

With the modern high-speed double-acting suction valveless type of air pump the total displacement volume per minute must still remain about the same. Each stroke is effective, however, and without the foot-valves the pump may be run much faster than with foot-valves as in the usual type. Due to these facts the actual displacement volume for one stroke may be made relatively much less than with the usual type of pump. Definite values will result as soon as the total displacement per minute and the number of effective strokes per minute are decided on.

Q. 284.—Please answer the following questions through Marine Engineering.

(1.) What is the difference in form of the go-ahead and backing sides of a screw propeller, and why?

(2.) Why are slide valves used on some cylinders and not on others of the same engine? L. M.

A.—(1.) In the general forms of screw propellers the go-ahead side or face of the propeller blade approximates in character to the surface of the true screw, while the backing side is convex in character, due to fact that the forces acting on the propeller require a certain amount of material for the requisite strength, and this material is placed upon the back of the blade.

(2.) The reason for the use of slide valves on the low-pressure cylinders of engines using piston valves on the other cylinders, is largely a question of design, and is mainly concerned with the problem of getting the engine within a definite and restricted space. The piston valves used on the high-pressure cylinders are considerably better in operation than the ordinary D slide valves, particularly with high-pressures, and where the question of space is not a paramount consideration they are often adopted on the low-pressure cylinders as well, but the more usual arrangement is to fit a slide valve on the large cylinders.

Q. 285.—Please answer in your next issue the following questions:

What amount of cooling surface is required per horsepower for outboard keel condenser; temperature of water 65 degrees? This is for a compound engine. Do you figure horsepower for condenser from high-pressure cylinder or from both? E. McC.

A.—The cooling surface for a condenser is figured rather from the steam consumption of the engine than from either the high-pressure or the low-pressure cylinder, or both. In practice, however, it is quite usual to figure the surface directly from the horsepower of the engine, assuming the latter to be obtained on a consumption of steam which does not differ greatly with different engines. The usual allowance for a marine engine of considerable size operating with a vacuum of 20 inches of mercury is 1 1-4 square feet of cooling surface per horsepower. Another way of getting at it is to make an allowance of 1 square foot of cooling

surface for every 20 pounds of steam condensed in one hour. This takes note of the varying efficiencies of different engines and is much the more accurate method. As the engine in question, operating with a keel condenser, is probably quite small, we may assume the steam consumption to be in the neighborhood of 30 pounds per horsepower per hour, in which case the condenser surface should be 1 1-2 pounds for each horsepower of the engine.

Q. 286.—The engines of a ship develop a certain I. H. P. in slack water. With the same M. E. P. will the I. H. P. be increased if the ship is running with a favorable current, and diminished with an opposing current? C. F. H.

A.—With a given M. E. P. the I. H. P. of an engine is directly proportional to the R. P. M. The R. P. M. obtained from the engine will not be affected by the current in which the ship is floating; because of the fact that with a given R. P. M. the ship's speed, *with relation to the water in which she floats,* will be constant. The speed of the ship, with regard to points on shore, will not be the same under the varying conditions of current and slack water, but this fact will not affect either the R. P. M. or the I. H. P.

Q. 287.—Charles H. Cramp said at a meeting before the Society of Naval Architects in 1894 that a shaft could not have more than 10,000 H. P. applied to it. The *Deutschland* has 35,000; *Lucania,* 30,000; *Kaiser Wilhelm II,* 40,000, and many others. Did he mean that a 22-inch shaft could not stand more than 10,000 H. P.? The steamboat *Puritan* has only one crank with a H. P. of 7,500. Are there any rules for figuring out how many revolutions a wheel like the *Puritan's* should make to make 20 miles per hour? F. B.

A.—The fact that under ordinary circumstances it was considered desirable in 1894 to limit the amount of horsepower used on one shaft to 10,000, has not militated against the occasional use of more than that amount on certain express steamers in transatlantic service. It is a fact, however, that the three ships mentioned, having engines of respectively 35,000, 30,000, and 40,000 horsepower, have two shafts each, thus dividing by two the amount of the total power which is applied to each shaft.

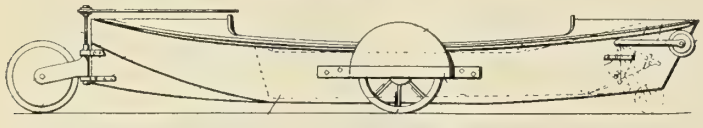
The number of revolutions required for a paddle wheel in a steamer making a given speed may be obtained from the formula:

$$R = \frac{88V}{\pi D\ (1 - s)}$$

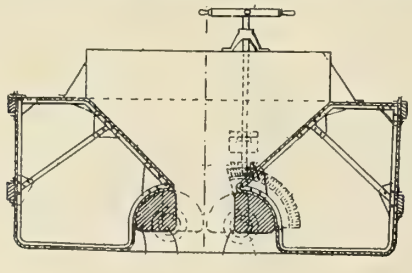
where V is the speed in miles per hour, D is the mean diameter of the paddle wheel to the middle of the blades, and s is the slip of the paddle. This value of s will vary usually from 15 to 20 percent.

SELECTED MARINE PATENTS.

780,835. SURF BOAT. BENJAMIN J. SUCH, WASHINGTON, D. C.
Claim.—4. The combination with a boat, combined paddle and traction wheels arranged at opposite sides of the boat, a motor for driving said wheels, and a combined steering wheel and rudder arranged at the stern of the boat, of a pair of wheels arranged at the bow of the boat on opposite sides thereof and adapted to project below the bottom of the boat, and means for raising said wheels above the water line. Nine claims.



784,286. HOPPER BARGE. JAN VOLKER-TYSZOON, DORDRECHT, NETHERLANDS.
Claim.—2. In a hopper barge, devices for opening and closing the discharging aperture in the bottom thereof which consist of rotatable portions of circular segmental section placed and working in chambers inside the barge parallel to the longitudinal axis thereof, and means for turning the said portions on their axes into such a position that they bear against each other when the discharging aperture is closed, or into such a position as will leave the said aperture free and clear when the discharging aperture is opened. Three claims.

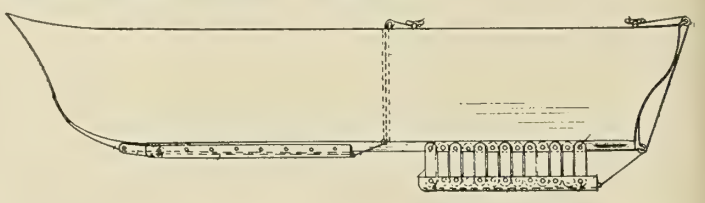


780,872. ENGINE FOR OPERATING CLAM-SHELL BUCKETS. JAMES G. DELANEY, NEWARK, N. J.
Claim.—8. An engine of the class described, having a drum for a bucket-hoisting cable, another drum for a bucket-operating cable, means for imparting traversing movement to the last-mentioned drum, means for locking the first drum at will, and means for insuring the simultaneous rotation of the drums when the traversing drum reaches the limit of the movement. Fourteen claims.

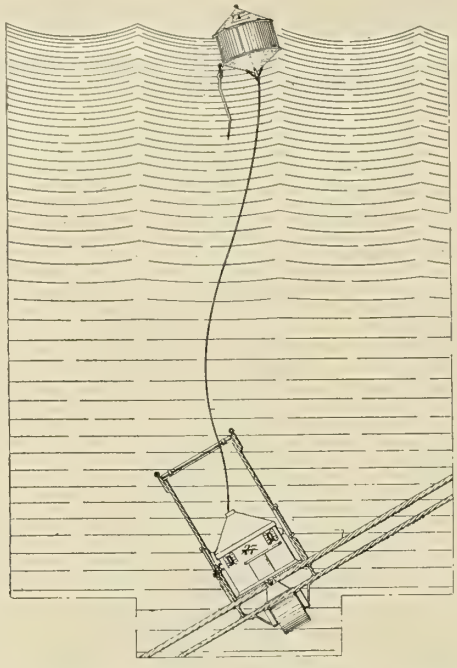
784,943. VESSEL FOR CARRYING ORE. FRANK K. HOOVER AND ARTHUR J. MASON, CHICAGO, ILL.
Claim.—5. In a boat of the character described, the combination with the outer shell or hull and a deck having hatchways formed therethrough, of a permanent inner bottom constructed to present alternate ridges and valleys extending across the vessel, the valleys lying directly beneath the hatchways and serving to contain the cargo, and the ridges lying between the hatchways and serving as internal bracing to strengthen the hull, substantially as described.

6. In a boat of the character described, the combination with the outer shell or hull and a deck having hatchways formed therethrough, of a water-ballast tank in said shell or hull having its top formed by a series of transverse ridges and valleys extending from side to side of the shell or hull, substantially as described. Six claims.

785,849. ADJUSTABLE KEEL FOR SHIPS OR BOATS. CHARLES ALBRECHT, CHICAGO, ILL.
This invention relates to an adjustable or drop keel which may be attached to the ordinary keel of a boat or to a false keel secured to the bottom of the boat, and which may be readily adjusted to project down into the water or folded up along the keel proper. One claim.



786,126. APPARATUS FOR MARKING SUNKEN VESSELS. FREDERICK W. JOHNSON, DAWSON, CAN., ASSIGNOR OF ONE-HALF TO JOHN P. PETERSON, DAWSON, CAN.
This invention relates to a means for marking sunken vessels and also for enabling the immediate recovery of the principal valuables on the ship—such, for example, as the ship's papers, specie, invoices, accounts, and other documents of the purser.



The apparatus comprises, broadly, a buoy which is connected with the vessel to rise to the surface as the vessel sinks. This buoy is connected with a box or vault in which is arranged a reel on which the line is wound, and the vault is also provided with compartments for the storage of the valuables of the ship. This box in turn is connected to the vessel by means of a line for which a second reel, permanently mounted on the vessel, is provided. Should the vessel sink, the buoy proper will immediately rise to the surface, and on doing so a ball therein will be released and the annular bell will be continually sounded. By hauling up on the buoy-line the vault or safe may be raised to the surface, and the position of the ship will yet be marked by the second line, which connects the vault with the hulk. Eight claims.